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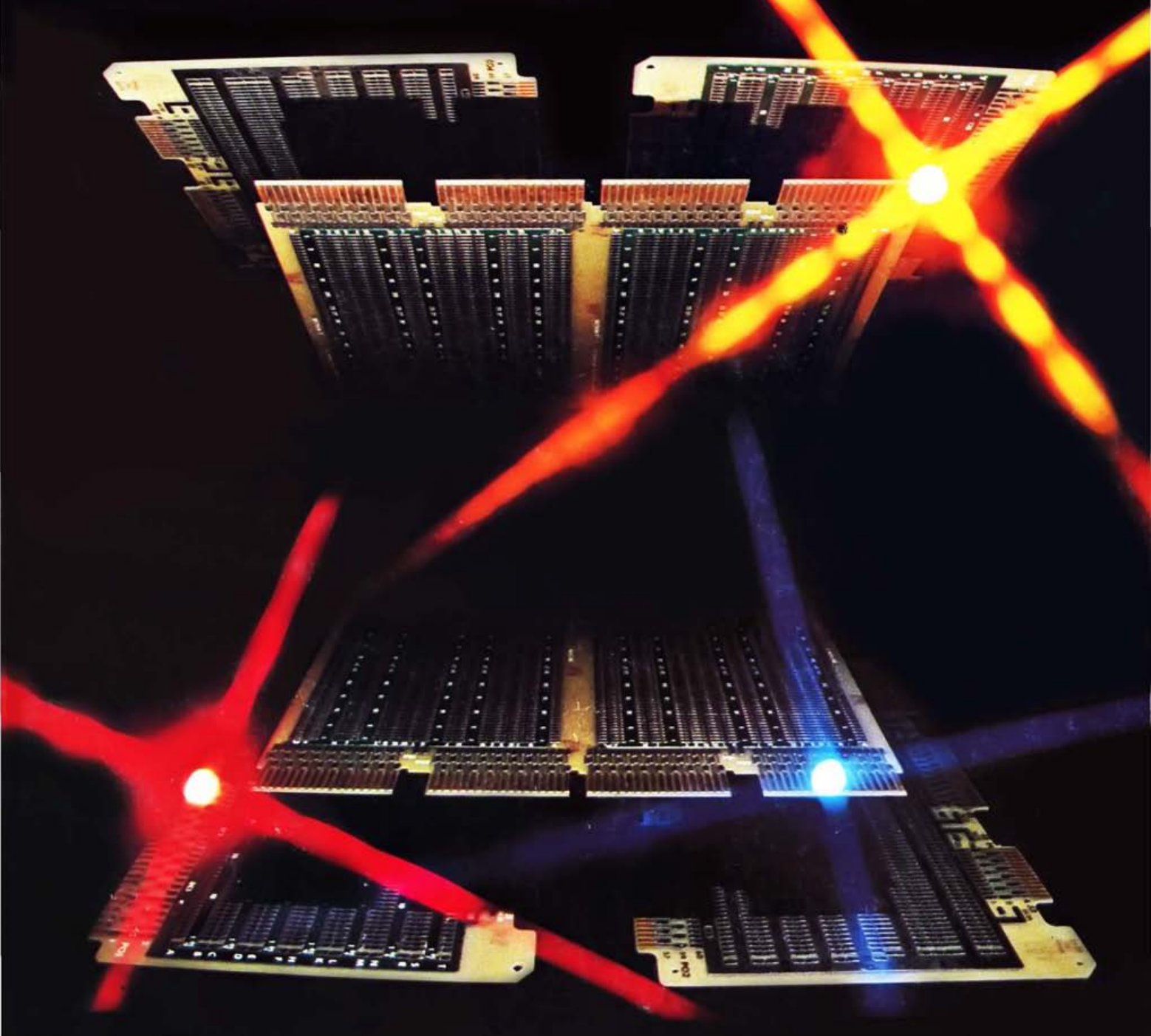
VOLUME 3, ISSUE 10 OCTOBER 1978 \$2.00

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## INDEX TO HARDWARE

Microprocessors in Autos

The 6800 in the Darkroom



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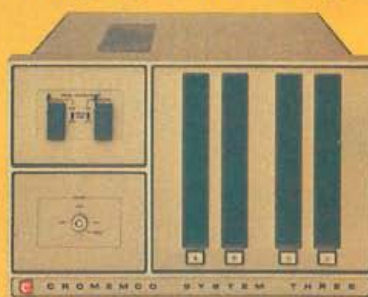
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## THIS MONTH'S COVER

Hardware has been the primary concern of the new microcomputer industry and in the last three years, the capabilities have become almost unbelievable in respect to the original designs.

The cover depicts the printed circuit boards that carry the data signals within the computer system. The reflective convergence of the cover epitomizes the industry's goal to bring dreams to reality.

The cover was provided courtesy of Multi Link, 2121 South Manchester Avenue, Anaheim, California, and is an example of their custom designed planar boards.

Advertiser Index .....	144
Calendar .....	28
The Column .....	14
Editor's Notebook .....	6
FIFO Flea Market .....	143
From the Fountainhead .....	46
Inventor's Sketchpad .....	50
Letters to the Editor .....	22
Micro-Market .....	142
Mind Revolution .....	43
New Products .....	120
Update .....	25
White Collar .....	
Microcomputer .....	34

## GENERAL FEATURES

INDEX TO HARDWARE .....	61
FIRST ANNUAL REVIEW OF AVAILABLE HARDWARE FROM TOTAL SYSTEMS TO PERIPHERALS	

A LOOK AT VECTOR GRAPHIC AND THE MZ .....	72
---	----

A BRIEF INSIGHT INTO THE ENGINEERING KNOW-HOW BEHIND VECTOR GRAPHIC PRODUCTS  
*by Carl Warren, Senior Editor*

A SPECIAL FUNCTION APPROXIMATION METHOD AND ITS APPLICATION .....	74
---	----

A PROGRAM TO ASSIST IN CALCULATING VARIABLE FUNCTIONS.  
*by Dr. Endre Semonyi*

THE AUTO INDUSTRY MOVES TO MICROPROCESSORS .....	78
--	----

THE AUTHORS REVIEW SOME OF THE CURRENT USES OF MICROS IN THE AUTO INDUSTRY AND OFFER THEIR THOUGHTS ON FURTHER POSSIBILITIES  
*by Robert S. Koster, M.B.A. and Leslie D. Ball, Ph.D.*

THE 6800 INVADES THE DARKROOM .....	82
-------------------------------------	----

HOW TO USE THE 6800 AS A DARKROOM CONTROLLER.  
*by R.B. Lang P.E. and C.J. Lang*

COMPUTER GENERATED MORSE CODE .....	86
-------------------------------------	----

HAMS, HERE'S A CHANCE TO UPGRADE YOUR CW ABILITIES.  
*by Jim McClure*

## BUSINESS FEATURES

BUSINESS EDITORIAL — BUSINESS MICROCOMPUTERS FRAUD OR REALITY .....	90
---	----

*by Rodney Zaks, Sybex Inc.*

OVERVIEW OF A BUSINESS COMPUTER SYSTEM .....	92
--	----

*by James Kitzmiller, Kitzmiller Systems*

THE AUTOMATED ATTORNEY .....	96
------------------------------	----

*by Matthew Tekulsky*

## HARDWARE FEATURES

HARD COPY: WHY NOT THE BEST? GO DAISYWHEEL .....	98
--	----

*by John MacDougall*

## SOFTWARE FEATURES

INTRODUCTION TO THE TEX LANGUAGE — PART III .....	126
---	-----

*by R.W. Berner*

GP MONITOR FOR M6800 — 4K-8K-16K or 32K .....	132
---	-----

*by William E. Warren*

A TEXT EDITOR FOR XEK AND PTCO ASSEMBLIES .....	138
---	-----

*by Dr. Alan R. Miller, Contributing Editor*

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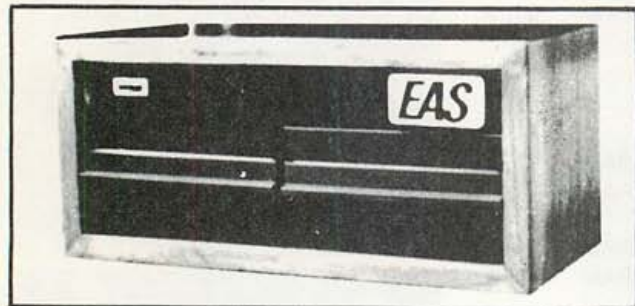
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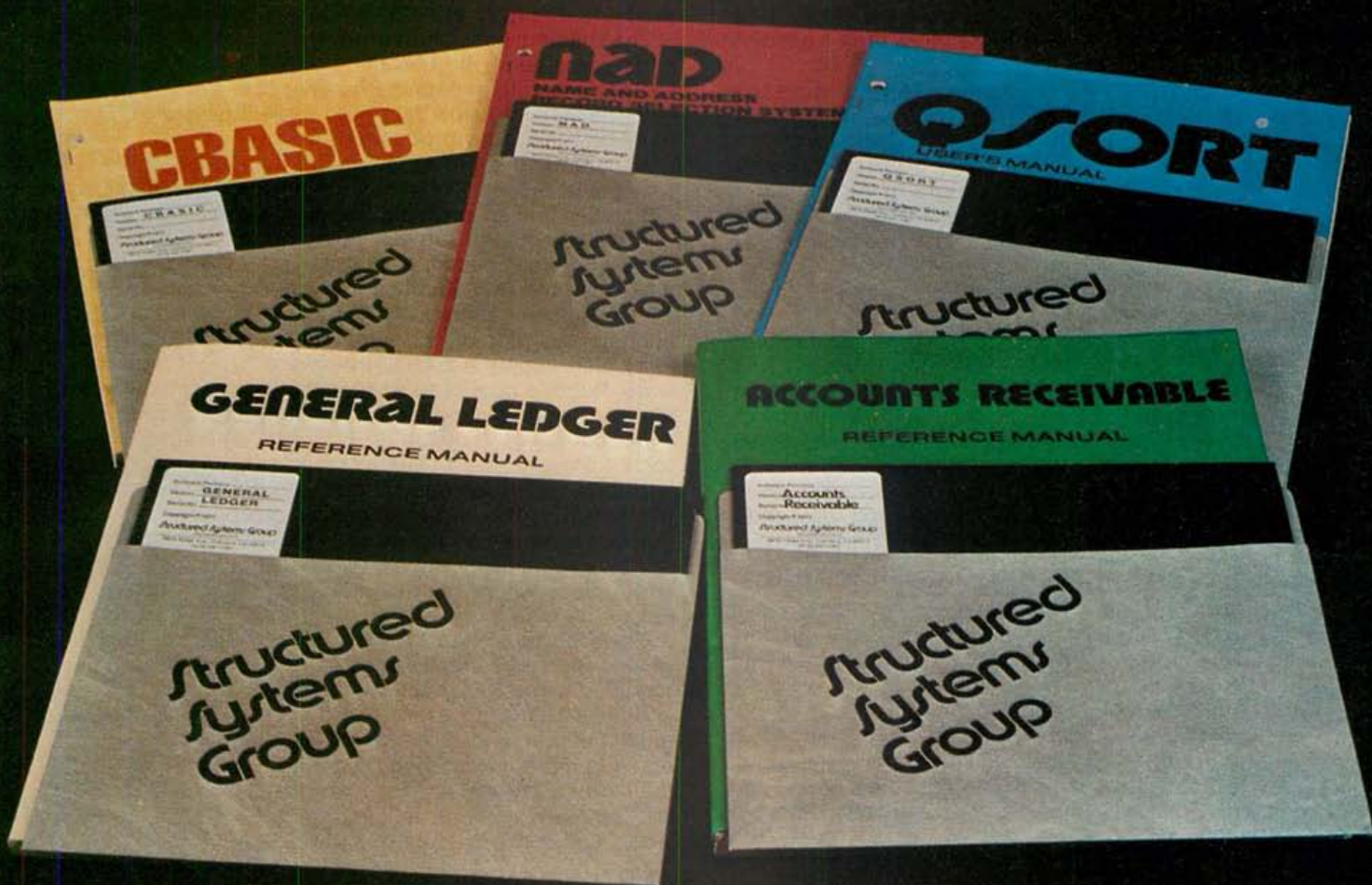
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# EDITOR'S NOTEBOOK

The last several weeks have really been exciting from my viewpoint. Many manufacturers are finishing up their new entrants to the market and are really starting to get enthused.

Nancy Millican of MECA, the people who make the Alpha I tape system, informed me that they are about to announce their Delta I disk system. The Delta I works in tandem with their tape system and provides the very first total storage package for the microcomputer market. Nancy said that with the way things are going it looks like they will be able to ship by late November or at the latest early December.

Another company that has been doing some really exciting work is "exatron" of Sunnyvale, California. This little company owned by Bob Howell is the manufacturer of a unique device called the "Stringy Floppy". This machine is a small continuous tape loop device which provides the speed of a floppy and the convenience of tape. The Stringy Floppy is designed primarily for S-100 bus type machines, but Bob has been working the last several months on developing an interface for 6800 based machines. From last reports it's just around the corner and will appear first in the pages of INTERFACE AGE.

## A LOOK AT SMOKE SIGNAL BROADCASTING

This month's profile is about a small company known to 6800 users called Smoke Signal Broadcasting. This company came into being about a year and a half ago with the sole purpose of supplying extras to the Southwest Technical Products 6800 microcomputer.

Originally Smoke Signal developed a 16K static RAM board which works extremely well in the SWTP system. However, in the last several months they have been developing 5.25-inch floppies with controller and are currently planning an 8-inch disk system.



With the Floppy system they provide a disk operating system that makes use of random access files. We plan a review by Bill Turner on the capabilities of this DOS.

Smoke Signal is in the process of preparing their very first total computer system, as of this writing still unnamed. This 6800 system utilizes a well designed mother board with gold molex pin connectors, built-in dual floppies, and up to 64K of memory. The formal an-

nouncement of the system will be in the November New Products directory of INTERFACE AGE.

The guiding light behind Smoke Signal is Ric Hammond, president. Ric has taken the approach that the way to run a microcomputer business is to stay current with the market needs but at the same time avoid trying to market too many products at a time.

Apparently this philosophy has worked well for them. As a result Smoke Signal has not suffered the financial difficulties that are plaguing several other manufacturers.

Heading up the software side of Smoke Signal is Roger Embree, manager of software systems. Roger developed the DOS and has made decisions to use the TSC assembler/editor and Software Dynamics BASIC compiler as part of the supplied software packages. They also supply a BASIC interpreter from Computerware. Roger's goal is to ensure that only the best possible software is supplied to Smoke Signal users.

Rounding out the team is Ed Martin, marketing director. Ed brought over 14 years of hardware and marketing knowhow to the company. When I asked him why he left the security of a larger company to come to Smoke Signal, his reply was like most of ours in this industry: "I see a dynamic company with a great big chance to grow and a place where my marketing talents can be really put to the test."

Ed is obviously up to the test; through his efforts Smoke Signal has really become one of the major contenders for the 6800 market share.

Smoke Signal is a small growing company with a great outlook. For those users and distributors interested in more information regarding Smoke Signal and their products contact: Ed Martin — Marketing Director, Smoke Signal Broadcasting, 6394 Yucca, Hollywood, CA 90028, or call (213) 462-5652.

## ANOTHER IMPORTANT BOOK AVAILABLE

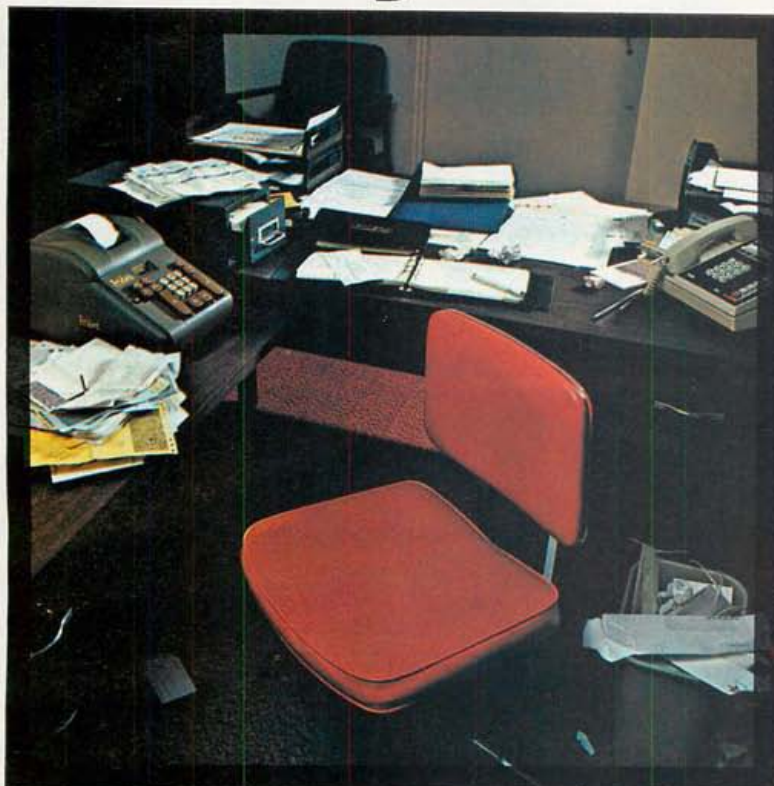
Books are one of the important tools of our industry, but it is sometimes difficult to find the exact one you need to help solve a problem. The folks at The Computer Bookstore recently sent me a pre-release copy of the booklet: *Master List of Computer Books*, spring edition. This booklet sells for \$1.50 and is really a must to round out the computer reference library. The book lists a number of reference sources and provides an order form so a reader can order them quickly. The booklet can be obtained from The Computer Bookstore, 796 Navy Street, Fort Walton Beach, FL 32548.

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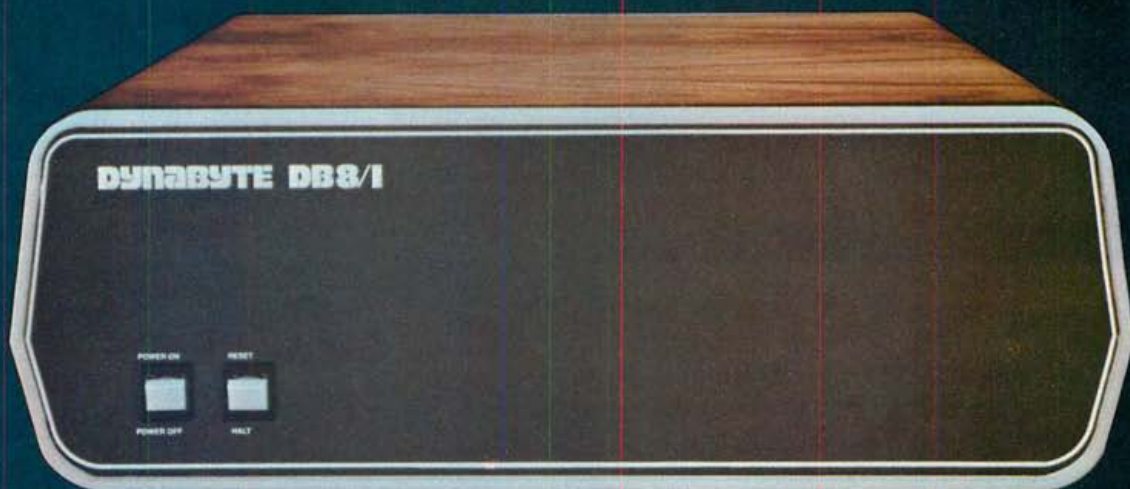
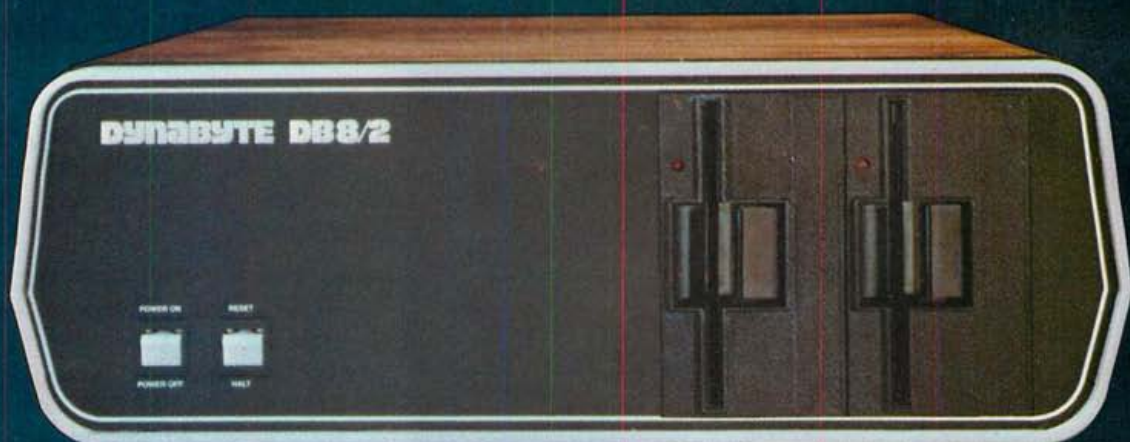
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\* CP/M is a trademark of Digital Research.

TRAN and COBOL programming languages. Our applications packages include general ledger, accounts receivable, word processing and many other CP/M compatible programs.

Reliability is a big consideration in buying a business computer, so we built it in. Our edge connectors meet military specifications, the toughest electronics manufacturing standard. Our regulated power supply is designed to meet U.L. standards, which means the entire system runs cool and dependable. And our cast aluminum enclosures are rugged as well as attractive.

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Z-80 program. George has helped us a great deal in removing some of the bugs that crept into the development of the standard. Mykro manufactures a K.C I/O Cassette Recorder Interface. The interface comes completely assembled with a bonus of the object tape of IAPS. The Mykro interface and IAPS make it possible to get the most out of your system in making totally portable tapes and reading IAPS formatted Floppy ROMs.

The Mykro interface is available for \$129.00 by contacting George Sutton, Mykro Corporation, P.O. Box 433, Los Altos, CA 94022 or calling (408) 733-8221.

## ANOTHER CONSULTANT ANSWERS CALL

In my August column I requested anyone who is in the consultant business to drop me a note, and I have now been getting responses.

The most recent that we have found is Marvin Mallon of Compu-Quote. Marvin's speciality is business and industrial applications. Working with a number of area dealers, he is able to provide a total service from establishing the hardware to preparing the application. For anyone interested in Mr. Mallon's service, he can be contacted at:

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I would like to hear from consultants in the midwest and east, so if you're in the business, drop me a note.

## GREAT EXPECTATIONS: CAN WE HAVE THEM?

Those of you who were at Personal Computing in Philadelphia this year probably recognize the head as the title of my talk.

Essentially, I was alluding to the impracticability of thinking that business systems which will handle all the

necessary accounting problems can be obtained for 600 dollars. Unfortunately, the industry has been giving the impression that the general business computer user can expect to have the same level of expectation from a 600 dollar micro as from a 25 thousand dollar mini or a multi million dollar maxi. **It just ain't so!**

Microcomputers are in the third generation of *iron* development but still in the last half of the first generation software. However, there is hope due to the efforts of many of the systems software designers and the growth of application designers. But regardless of how well these people do their jobs, the 600 dollar business machine will not exist.

Consequently, it is extremely important that not only the user educate himself but the vendor of business systems do so also. Pretending that high level capability, flexibility and reliability can be found in less than adequate machines is foolhardy on everybody's part.

The consumer computer is another area in which the industry has been fooling the public. The consumer computer is not a fact or even a probable reality in the foreseeable future. The reason for this is very clear in my mind. Why would anyone buy three thousand dollars worth of hardware to do a job that a ten dollar timer from the hardware store will do equally as well? Or as one reader that I talked to put it: "My wife doesn't even balance the checkbook now, so how can I expect her to do it on a computer?"

Even though I enjoy computers more than most, I really think that putting them into all aspects of daily life would be a travesty rather than a help. Already we have become too oriented to relying on so-called work saving devices than on our own initiative. Personally I think it would be better to keep the computer in business and industry and maintain our personal abilities as humans.

—carl

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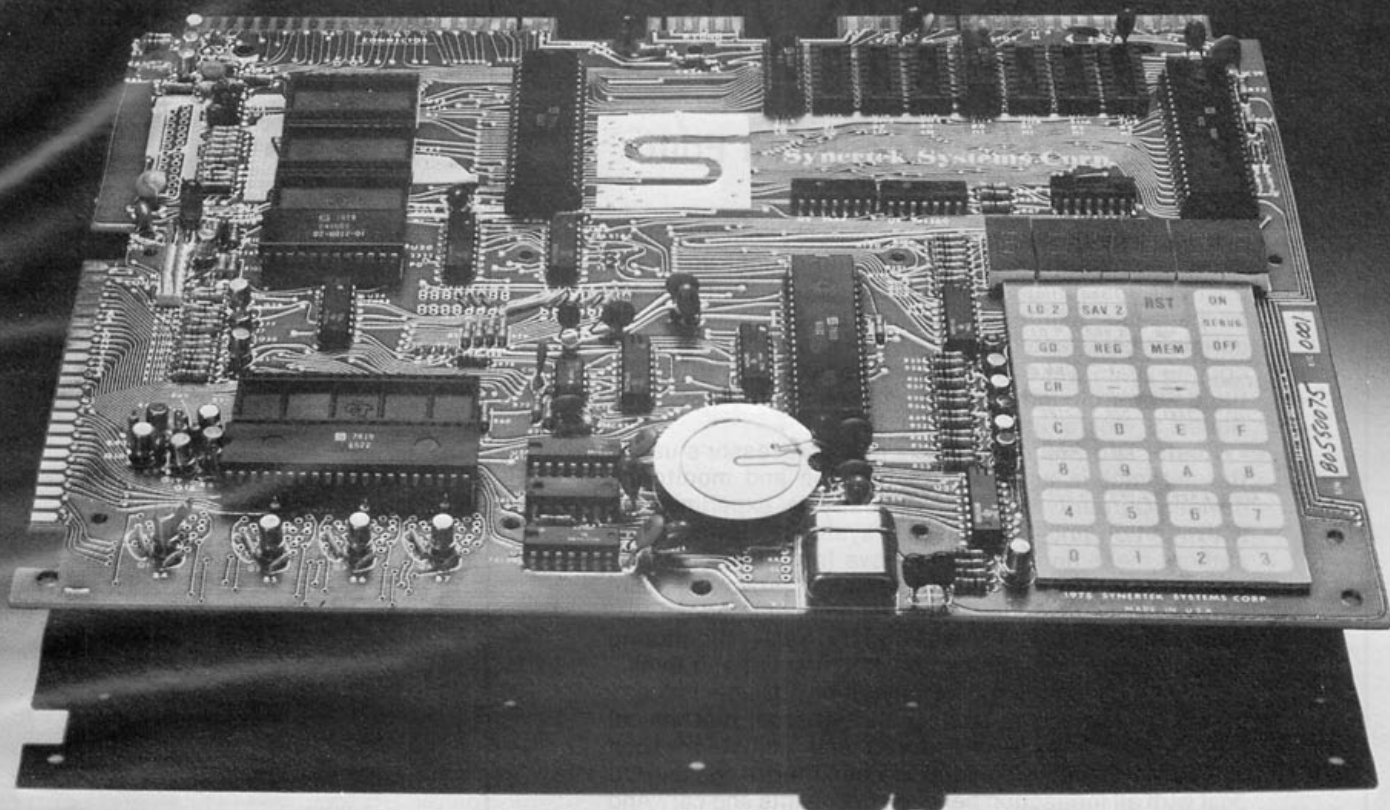
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# THE COLUMN



By Sandra Evans, Assistant Editor

It seems impossible to read an article about the future use of computers without becoming caught up in the realm of possibilities rather than actualities. There are so many possibilities in any one field that our lives will certainly be affected greatly by these machines in the coming years. Take a moment to consider the article entitled "The Auto Industry Moves to Microprocessors" by Robert S. Koster and Leslie D. Ball.

Koster and Ball discuss the microprocessor's use in the automobile as a control function and monitoring device. Currently the auto industry is experimenting with ignition and transmission systems. However, the authors make an interesting move from the actualities of engine control into the more thought provoking realm of possibility. Their discussion of alcohol interlock systems, automatic radar brakes and brain wave monitoring devices causes one to lean back a moment and think.

Given the technology, wouldn't it be possible for computers to advance to such a state that all mechanical processes could be monitored and adjusted? Then wouldn't it be a logical step to computerize the auto to deal with all interaction between occupants and car? And finally, if brain wave scanning were a fact, couldn't the car be programmed to react to both human physiology and psychology?

If it could, the car might be programmed to your own particular needs and tastes.

When purchasing a car, you would not only be faced with the normal options of vinyl interior, AM/FM radio, power steering or disk brakes. You would also be confronted with options which could control every movement within the automobile. You could literally create your own personalized car. Naturally the microprocessor would monitor and maintain engine performance. But what about luxury?

Suppose you're the sporty type. Now you order a sports car with dual overhead cams and a racing stripe. But you may one day be able to order a car which could actually simulate racing conditions. Driving the freeway could be like driving the Indianapolis Raceway. Not only would your car be outfitted like a race driver's, it would also simulate speed, vibrate, provide you with squeals in stereo, and turn corners as if you were driving on two wheels.

Behavior modification could also fit in nicely with this idea of personalized driving. If your driving needs to be improved, why not program your auto to zap you with an electrical shock when you make those quick left hand turns or tailgate the car in front of you? And if you maintain the inconsiderate habit of lane changing without signaling, you could program the car to turn on a gentle seat massage when you do remember to use your blinker.

Whatever your image is, whatever your desires are, the car of the future waits for you. The options are yours. How will you design it? □



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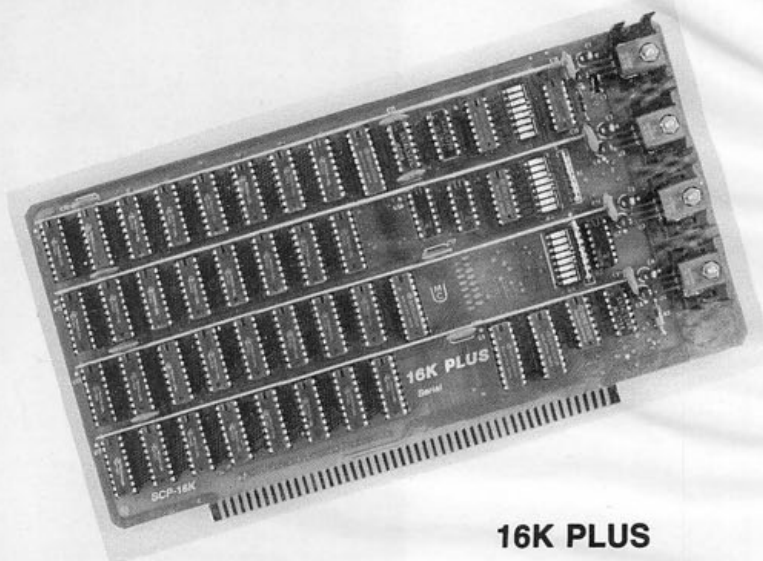
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# LETTERS TO THE EDITOR

Dear Editor:

After rereading the four parts of Roger Williams' article I still think all I have read is a term paper on computers in business. Lots of "WHY" but very little "HOW".

Part four says all anyone needs is a programmer who is fluent in all the program languages known to man, a systems analyst with a PhD in E.S.P. along with a lifetime each in business and computer systems. System software that can run on anything from a TRS-80 to IBM 370. Applications programs so good they don't need a CPU. Along with all the source code. NUTS.

Why is it on page 16 (August) Dr. Osborne says "no naming names" yet on page 42 TDL and XITAN get it?

Could you have Dr. Osborne put an "X" by those manufacturers, in your advertiser index each month, who are unsound?

Anyone have something to say?

Bob Distler  
(805) 487-7422  
P.O. Box 6376  
Oxnard, CA 93031

*Before Bob sent me this letter, he called to discuss his general philosophy regarding the state of the art in general and data processing specifically. One of the questions he brought up on the phone was why everything is disk oriented and did we know of anyone who could give him a "crash" proof argument to support the use of disks and disks only. He also brought up some other ideas and gave us what we feel to be unique insights. Hopefully sometime early next year he will be providing you with some of his expertise in the computer field in the form of a column called RHD, which happens to be his initials and the name of a tape handling program that he has written.*

*In the meantime Bob would very much like to hear from you either by phone or letter. And believe me it will be a worthwhile experience.*

Dear Editor:

A few notes from a satisfied Canadian reader:

1. Items move faster through our mail system if you include the Postal Code. This is that funny series of letters and numbers

that appear after the province. My postal code is V6S 1B2. Note that the format is letter, number, letter, space, number, letter number. Although this may not be quite as simple as your ZIP code, it does mean that a letter addressed:

Andrew Bates,  
Canada V6S 1B2

will be delivered to me. The postal code pinpoints the side of the street in a residential block or even the floor of a building in a business district. How's that for precise!

Software writers take note: We Canadians need at least 6 characters for the postal code and 4 characters for the province (state). And if you are going to check the ZIP for all numbers, please put the check in a sub-routine so we can replace it with a suitable check for our postal code.

2. WATTS lines do not cross international borders (at least that is what the telephone operator told me). This means that we people in Canada can't phone you for free like everyone else can. How about letting your people accept collect phone calls from Canada, only so we can use A.G. Bell's famous invention, instead of having to spend hours slugging away at the old typewriter and then waiting for what is an erratic mail service on both sides of the border.
3. Another small request for software writers who are mailing things to Canada: If your package costs \$75.00 and is distributed on North Star diskette, for instance, please mark the customs declaration as:  
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If you mark the price as \$75.00 we end up paying duty on the diskette as though it cost \$75.00. Printed matter comes across the border duty free and there is no duty on an item of less than \$10.00 value.

Thanks for listening.

Andrew Bates  
Vancouver, B.C., Canada

*Andrew, your points are well taken and we would imagine that a number of manufacturers are listening to what you are saying. Yes, the mail is bad and phone rates high, but to get the business a WATTS line would be an excellent idea.*

Dear Editor:

Thank you for Floppy ROM™ No. 4 and IAPS™.

After keying program 4 with some corrections my system was able to decode the Floppy ROM. Then the program source file was read as input to BASIC. I am very pleased to say that it worked flawlessly.

My personal use Altair 8800b does not have a disk system yet so I was not able to use the programs. Hopefully future Floppy ROMs may have non-disk applications.

Equipment used:

Altair 8800b with 24K of memory  
MITS BASIC version 4.1  
MITS 2SIO serial I/O  
Panasonic stereo system  
(receiver with turntable)  
Sony TC 205 portable cassette

A few checksum errors occurred until I advanced the volume control just slightly. No other problems.

John B. Palmer  
Boonville, CA

*John, we thank you for the kind words, and your letter is representative of a little over 400 we have received to date on Floppy ROM #4 and IAPS. Most of the users appear to like the IAPS idea and have provided us with a great deal of input on how to improve it.*

*If you were lucky enough to be at PCC '78 in Philadelphia this year, you probably heard Bill Turner, the inventor of IAPS define the complete standard in his talk. If not, we are going to publish the talk and guidebook to IAPS in the November issue. Beginning with the January 1979 issue all Floppy ROMs will be in the IAPS format, plus we will begin asking for software articles to be accompanied by a cassette tape at 300 baud and in the IAPS format.*

Dear Editor:

Reference the article by Dr. Jerald L. Ripley, "DEBBI — A User Report" in the June 1978 issue, I too have used DEBBI for several months and would like to question one of Dr. Ripley's problems and point out others.

There are six versions of DEBBI, each designed to run on one of the following microcomputer systems: Intel MDS, SBC 80/10 or 8/20, MITS/Altair, IMSAI, PolyMorphic or Sol. I use the IMSAI (-58) version in a Vector One with ICOM 3712 dual disk drives, but since Dr. Ripley did not state which version he used, some of the following comments may not be valid for his version.

The solution to the first problem mentioned, slow loading from disk due to a listing on the console is to enter Control/O following the DLOAD command. This suppresses all output until another Control/O is entered and is documented on page 5-29 of the DEBBI manual.

DEBBI is definitely a version of MITS/ALTAIR/Micro Soft BASIC, as Pertec now owns both MITS and ICOM. This brings us to what I consider DEBBI's greatest shortcoming, its lack of random files and ability to have open only one input and one output file at any one time. According to one of ICOM's software people, this lack of disk I/O flexibility was left out of DEBBI so it would not compete directly with MITS BASIC in the business applications market.

In summary, DEBBI is an excellent extended BASIC, with lots of whistles and bells, but seems to fall short of a usable disk BASIC. In addition, ICOM's documentation of both DEBBI and FDOS-III has several minor errors and is not as complete as one would wish; however, a letter or phone call to them should get you corrections for all the known mistakes.

I hope that this information is of interest to some of your readers and that Dr. Ripley does not take offense at any of my comments regarding his article.

R.E. Wilson  
Dallas, TX

*DEBBI is a reasonable extended BASIC, but as we were working on Dr. Ripley's article we found it necessary to call Pertec and ask for their thoughts. They also felt it was a reasonable BASIC but fell*

*short of their expectations as a disk BASIC. It appears that the general feeling among other readers is that there is much better available so why even consider DEBBI at this stage of the game.*

Dear Editor:

Can anyone tell me how two or more persons all using their own TRS-80 can play games over the phone lines so each person's video shows the same thing and reacts identically? Please specify how to make or where to buy any additional hardware that may be required.

Also, it's really frustrating to want to use a LI program and can't because you have LII. In most cases, I don't know how to re-do my LI tapes so they'll run on LII. I've got 16K LII and most of my LI tapes still come back with "program too long" after using the conversion tape on them.

Can anyone tell me how to easily change my LII back to LI and vice versa or know of anyone who has developed an inexpensive device to do this without having to bother with LI to LII tape conversions?

Sharon Jackson  
P.O. Box 621  
Fenton, MO 63026

*Sharon, that's a thought provoking idea. Somebody has probably figured out how to set up a communications net for the TRS-80, only we haven't heard about it yet. If any TRS-80 user group has worked on this let Sharon know and us too.*

Dear Editor:

As soon as I get your magazine, I read Adam Osborne's *From the Fountainhead* because his candor is much needed in the hobbyist computer market.

But not his June 1978 column. He omitted Step Zero which is crucial and absolutely essential. Step Zero is the question: Do you want a computer for games or for business? If anyone wants a computer for business, then he wants to buy a Wang, a Hewlett Packard, an IBM, etc.

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Enough about us. How about what computers do. To attempt to describe all the things your computer might do, would be to describe your imagination. So instead, we'll briefly list some of the many things for which small computers are already being used.

**In business,** the advent of the versatile and compact microcomputer has put the benefits of computing within reach of small companies. With systems starting at less than \$6000, the businessman can

computerize things like accounting, inventory control, record keeping, word processing and more. The net result is the reduction of administrative overhead and the improvement of efficiency which allows the business to be managed more effectively.

**In the home,** a computer can be used for personal budgeting, tracking the stock market, evaluating investment opportunities, controlling heating to conserve energy, running security alarm systems, automating the garden's watering, storing recipes, designing challenging games, tutoring the children . . . and the list goes on.

**In industry,** the basic applications are in engineering development, process control, and scientific and analytical work. Users of microcomputers in industry have found them to be reliable, cost-effective tools which provide computing capability to many who would otherwise have to wait for time on a big computer, or work with no computer at all.

## COMPUTERS FOR THE HOME



## COMPUTERS FOR INDUSTRY

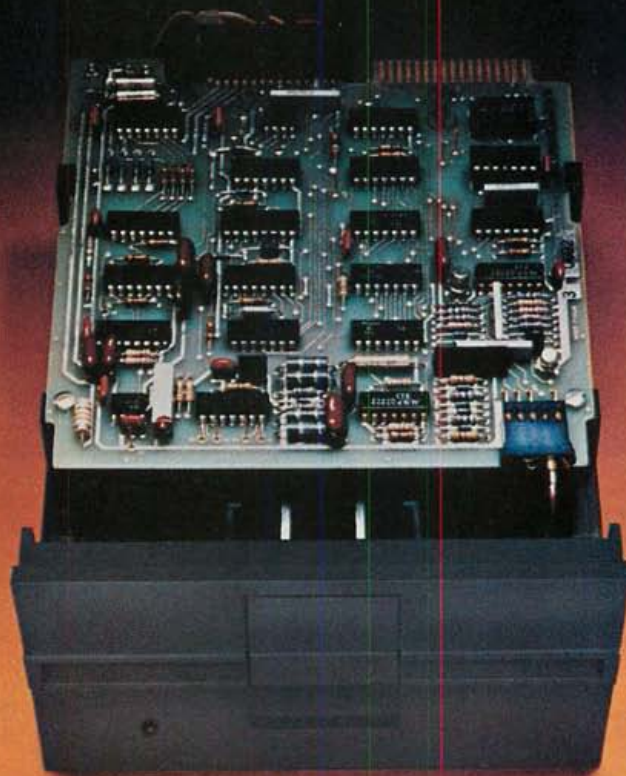


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See opposite page for list of manufacturers featuring Shugart's minifloppy in their systems.

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# Look for Shugart drives in personal computer systems made by these companies.

The kit computers, the hobby computers, the personal computers, are strictly tinker toys. They are all right for playing Star Trek, black-jack, etc., but no one should attempt to use them for anything serious.

We have 100 manufacturers for the S-100 bus. None talk to the others. It is positively amazing how little of this gross incompatibility of parts is ever mentioned in the computer magazines.

Documentation is either non-existent or stinks.

Service is a joke. Where do you get boards serviced?

My North Star disks went down for five weeks last summer, and again for six weeks this summer. There is no local repair shop. North Star repaired them, but then left the repaired units on their shelf for eight days *after* fixing them, and then shipped them surface UPS, instead of Blue Label Air UPS! Is that any way to run a business?

How do you tell employees that they must wait for six weeks for their paychecks because the payroll program won't work on a DOWN computer?

I put \$10,000 and two years of work into my computer — my personal, hobbyist computer. So far, I have had about one good month of use out of it. To base a business on this computer, one would have to desire commercial suicide with passion.

A true commercial computer (Wang, Hewlett Packard, IBM) costs no more than hobbyist junk; it runs as soon as you get it; the documentation is excellent; it can be serviced in a day; and it has business programs ready to run.

Edward L. Tottle  
Baltimore, MD

*The only thing that you can say when the computer goes down on payday is: "great expectations, can you have them?" Probably not.*

Dear Editor:

The Spain Rehabilitation Center at the University of Alabama Medical Center has a project underway to demonstrate both the utility and economic feasibility of the new generation of 'personal' computers for use by the severely disabled. The

programmability of the computer will allow it to serve as a general purpose appliance to be used as an aid to communication and education as well as for environmental control and entertainment.

This system, as currently envisioned, will consist of a microcomputer, an on-line storage device for programs and data, two T.V. monitors for user feedback and information display, a printing device for typed output, a speech recognition device for vocal input of commands, data, and text, a powerline controller for environmental control, and a telephone dialing/answering device. We are attempting to select components which are widely distributed and serviced as well as being plug compatible and economically priced.

Programs will be written or purchased to perform specific functions in each of the four general areas mentioned above. However, we would be very interested in receiving ideas from your readers, particularly those who are disabled, those who have disabled friends or relatives, and those who have personal computers and would like to develop hardware or software for the system on their own, regarding specific functions which they would like to see developed and which could be accommodated by the proposed microcomputer system.

We are sending this letter to several publications and organizations in order to reach as many people as possible and are looking forward to receiving input from anyone who may be interested in this project.

Charles Healey, Research Associate  
Spain Rehabilitation Center  
U.A.B. University Station  
Birmingham, AL 35294  
(205) 934-3320

*This sounds like a very worthwhile and exciting venture. So since you included us in one of the "many" publications, let's see if some of our readers will supply the necessary input.*

Dear Editor:

Help! I am a home brew computer hobbyist who needs an operating system. So I am writing to you in the hope that you or one of INTERFACE

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1201 10th Street  
Berkeley, CA 94710

**Vista Computer Company**  
2807 Oregon Court  
Torrence, CA 90503

AGE's many readers will please come to my rescue.

I have a home brew '8080' based computer system with a Sykes digital magnetic tape unit that I have interfaced to look like a floppy disk. But I cannot find an operating system to use with it.

Is there any place a home brew computer hobbyist can get a source listing and maybe a paper tape copy of a disk-type operating system to use on a non-standard hobbyist computer system using disk and/or digital magnetic tape?

Glenn Moss  
450 N. Mathilda, Apt. Q306  
Sunnyvale, CA 94086

*Yes, Glenn, there is. Many of the magazines, including us have published complete operating systems that can be customized to meet a specific need. We suggest that you contact Jim Schreier, the man that puts out the SSI Microcomputer Software guide, at SSI, 4327 Grove Street, Phoenix, AZ 85040, and order his book for \$7.95. It is the most comprehensive book on available software on the market today. If that doesn't work we have published your full address so other readers can possibly help you out.*

Dear Editor:

I read with interest the query of Brother Meyerpeter and your reply concerning the educational uses of microcomputers.

I would highly recommend that you contact Dr. John Hirschbuhl at the University of Akron, Akron, Ohio.

He is by far the leading authority in Computer Aided Education in the United States and most probably, the world.

For your future issue on this subject, John would prove to be your best source for lead articles and the review of other material. His expertise ranges the entire spectrum from psychology of learning and teaching techniques to hardware and software.

John Hodges, President  
Kent-Moore Instrument Co.  
Pioneer, OH

*We suggest all interested parties should also contact him.*

Dear Editor:

Re: HELP!

Being a computer enthusiast like many others, I am very anxious in setting up a computer hobbyist/computer user's club with the help of a few of my friends. However, the situation here is not as favorable as might be expected; firstly, most of us lack the necessary technical backing, and secondly, there is a severe shortage of technically qualified personnel who are able or free to help.

Hence I would be most obliged if any of your readers, who are committee members of any clubs/societies, or anybody who might like to help, can provide me with information on how their club/societies were started, how are their meetings carried out/what they do during their meetings, the problems they faced, as well as any other tips and information that might be helpful in the course of setting up a club locally, which may be the first in Singapore.

In anticipation of any form of help anyone might provide, I would like to thank him/her in advance.

Steven Goh  
3, Bristol Road,  
Singapore 8, Singapore

*Steve, let's see if you get any answers.*

Dear Editor:

In the last issue we received (April 1978) you mentioned the beginning of the microcomputer in Europe. We would appreciate if you could let readers from your magazine know that we handle some of the U.S. products. We are handling Europe for Meca Alpha-1, also TDL for Holland, Selecterm and Central Data too.

Due to the fact that we buy centrally, we can give our customers the same price as they would have to pay in the U.S., but of course we have to add import duties, etc. This relieves the customers of all these problems.

We are trying to get more software here and we are willing to cooperate with readers in the U.S. to swap information.

J. Boers  
Medel B.V., P.O. Box 135  
9300 AC Roden, Nederland  
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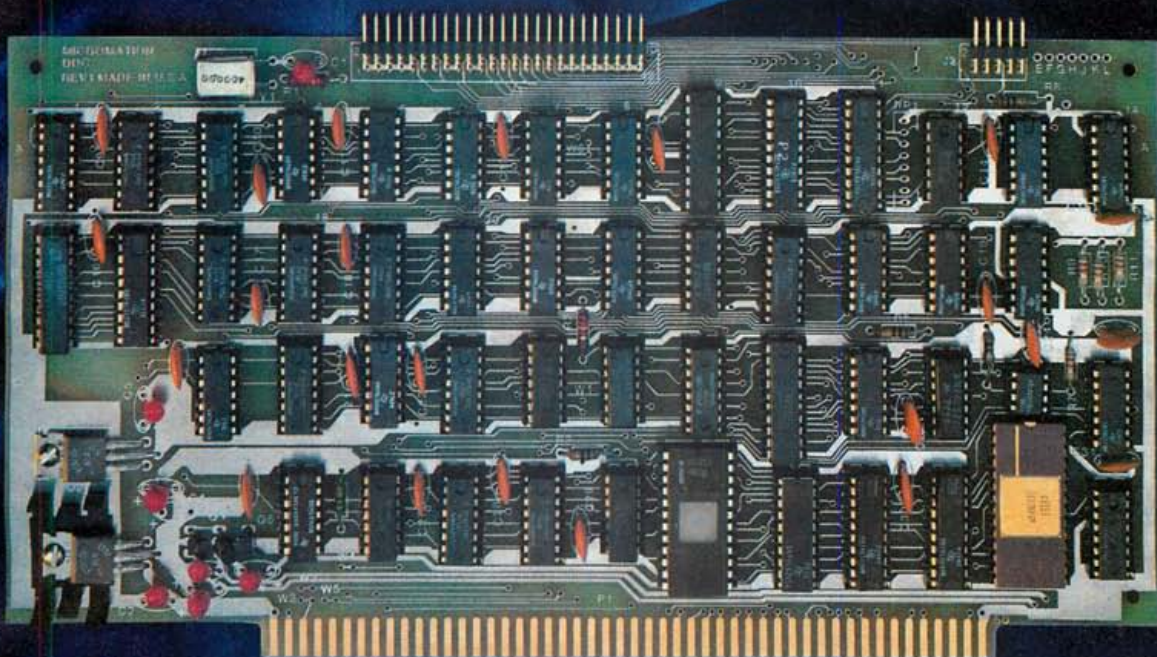
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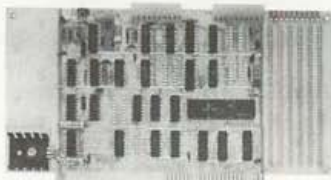


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## NOCCC COMPUTER SWAP MEET

The largest computer swap meet will be held on Sunday, October 15, 1978 starting at 9:30 a.m. through 3:30 p.m. All computeroids and hobbyists interested in buying or selling should not miss this event.

The Northern Orange County Computer Club (NOCCC) in conjunction with Advanced Computer Products are co-sponsoring this year's swap meet.

It will take place at 1310 E. Edinger in Santa Ana, California. For more information and space reservations call Alice at (714) 558-8813.

## EICO DATA PRODUCTS FORMED

A new company specializing in the marketing and distribution of computer terminals has been formed. Called EICO Data Products, it is a division of EICO Electronic Instrument Company, Inc. (O-T-C). Heading the new company is Ms. Linda Ashley whose background includes small business management, education and mathematics.

Ms. Ashley indicated that her company will distribute several types of terminals which will be sold outright or will be available on a lease basis. The terminals can be incorporated into computer systems used by businesses, educational institutions, and personal computers. Terminals serve the function of distributing data-processing information.

For further details contact Ms. Linda Ashley at EICO Data Products, 108 New South Rd., Hicksville, NY 11801 or phone (516) 681-9307.

## JEDEC RELEASES CLASS B & C MICROCIRCUIT STANDARD

Responsive to a long-standing need expressed by several user groups, who form the customer base of the semiconductor manufacturing industry, the Joint Electron Device Engineering Council (JEDEC), sponsored by the Electronic Industries Association (EIA), the national Electrical Manufacturers Association (NEMA), and the industry at large, has released JEDEC Publication No. 101 governing JEDEC Requirements for Class B & C Microcircuits.

Publication No. 101, written by the JC13.2 Committee on Government Liaison for Microelectronic Devices, provides an opportunity for OEMs to use a standard quote vehicle and uniform processing spec

which can commonly be used by manufacturer and user alike. The Committee, which has representation from most semiconductor houses across the industry, unanimously approved the spec for use as a standard approach to attempt resolution of the long-standing need from the user community.

The method outlined in Publication No. 101 provides for the use of each manufacturer's own data

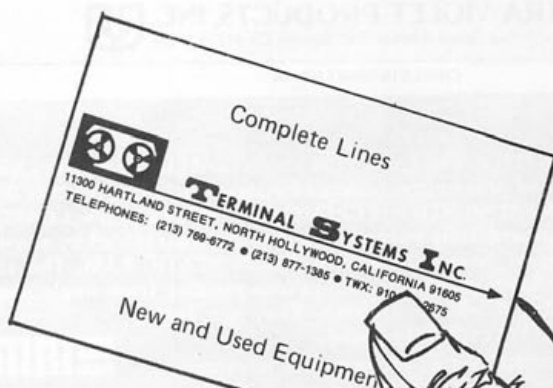
sheet, in tandem with standard screening and testing sequences specified in MIL-STD-883 and MIL-M-38510. As an aid to identifying "part" to "spec", a marking standard has also been established which identifies the part by its manufacturer's device type number with a suffix designator JC relating it to the JEDEC sponsored Publication No. 101 specified conditions. Additional marketing specified in

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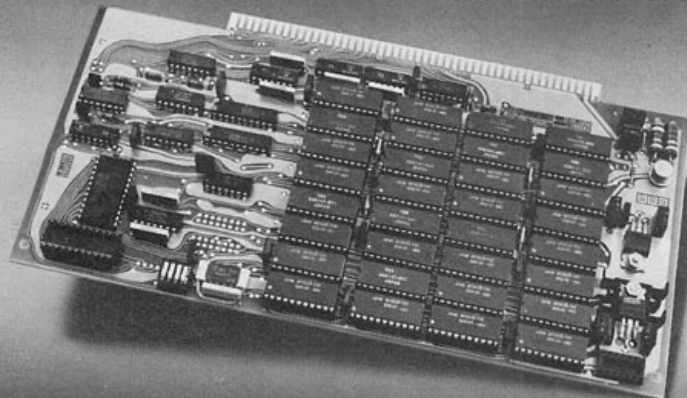
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MIL-M-38510 is used to complete the identification for these products.

Copies of the publication are available from EIA's Engineering Department, Standard Sales Office, 2001 Eye St., NW, Washington, D.C. 20006, at a nominal \$2.00 per copy.

### DUAL IN-LINE LEAD SOCKET PANEL STANDARDS SET

The Electronic Industries Association announces the availability of a new standard, RS-444, "Dimensional and Electrical Characteristics Defining Dual In-Line Lead Socket Panels." A socket panel is a printed circuit board with female contacts inserted through holes in the board. These holes are to receive DIP sockets. This publication establishes a unified numbering system to be used for dual in-line lead socket panels standardized by EIA, and provides standard test methods, gauges and performance requirements for use in the description of these sockets. Performance requirements of sockets described by RS-444 are covered in EIA standard RS-415, "Dimensional and Electrical Characteristics Defining Dual In-Line Type Sockets."

Copies of RS-444 may be ordered at \$4.00 each from the Standard Sales Office, Electronic Industries Association, 2001 Eye St., N.W., Washington, D.C. 20006. A free Index of EIA & JEDEC Standards and Engineering Publications is also available upon request.

### EIA DEFINES PHONE PLUG AND JACK STANDARDS

The Electronic Industries Association Engineering Department announces the availability of RS-453, "Dimensional Mechanical and Electrical Characteristics Defining Phone Plugs and Jacks." This standard which covers dimensional characteristics and mechanical and electrical values is the culmination of many years' work by the EIA Working Group on Sockets, P-5.2. It is intended to provide standard statements of marking, test conditions, dielectric withstanding voltage, contact resistance, and mechanical dimensions with tolerances in both the inch and metric systems.

Copies of the new standard may be ordered from the Standard Sales Office, EIA, 2001 Eye St., N.W., Washington, D.C. 20006.

## STANDARDS ON RACKS, PANELS AND ASSOCIATED EQUIPMENT UPDATED

The Electronic Industries Association Engineering Department has revised RS-310. The most recent revision of this thirty-year-old standard, RS-310-C, "Racks, Panels and Associated Equipment," contains updated dimensions to ensure complete compatibility between racks and electronic gear to be mounted in such racks. This standard should serve as an important communication device between manufacturers and users in the electronics industry. The dimensioning has been based on the positional tolerance (true position) concept and has been given in inches and millimeters to facilitate the conversion to the metric system.

Available at \$4.00 each, copies of RS-310-C may be ordered from the Standard Sales Office, Electronic Industries Association, 2001 Eye St., N.W., Washington, D.C. 20006.

## TANDY COMPUTER USERS GROUP FORMED

The National Capitol Chapter of the Tandy Computer Users Group has been formed. General membership meetings are held the last Wednesday of each month. The group is open to any and all interested persons. For more details on group activities, you may write to the group President, Rod Wright, 8205 Chivalry Rd., Annandale, VA 22003, or call him at (703) 560-5854.

## MINI/MICRO COMMITTEE FORMED

The formation of a Mini-Micro Committee to address the concerns of the developing software products and turnkey system industry using micro and minicomputers was announced by the Software Industry Association of ADAPSO. The purpose of this trade association committee is to work in the interest of member software firms and hardware manufacturers supplying software. Issues planned for discussion include the marketing of software, software support, software protection, technology transfer and training, taxation, pricing, product standards, users groups, plus others that members feel are of general interest and appropriate to the trade association.

Companies interested in further information on the Mini-Micro Com-

mittee should contact Stephen M. Hicks, Chairman, Mini-Micro Committee, Forth, Inc., 815 Manhattan Ave., Manhattan Beach, CA 90266, (213) 372-8493.

## ATLANTIC RESEARCH OFFERS COURSE ON DATA COMMUNICATION BASICS

Atlantic Research is offering a two-day course on data communications titled, "An Introduction to Basic Concepts and Systems."

The first day of the course will deal with such basics as system components and their functions within the data communication facility; front ends, concentrators, transmission facilities, modems and terminals; the communication channel and its basic capacity; network organization and methods of encoding data onto the communication channel.

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The two-day course costs \$250 and is scheduled to be held in a number of cities throughout the United States:

June 19, 20	New York, NY
July 17, 18	Chicago, IL
August 7, 8	Washington, DC
October 16, 17	Washington, DC
December 4, 5	San Francisco, CA

For more information contact Atlantic Research Corp., Teleproducts Div., 5390 Cherokee Ave., Alexandria, VA 22314, (703) 354-3400.

## DATA BASE SYSTEMS PUBLISHED

Ronald G. Ross has released a new book, *Data Base Systems*. Published by AMACOM, it is the first comprehensive guide to the still growing field of data base technology.

Ross supplies an introduction to data base management systems as well as a discussion of the evolution of it. He also looks at the direction in which the systems is moving and the practical implementation and management of data base systems.

In addition, *Data Base Systems* describes the various techniques that are currently on the market and looks at the differences between them.

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# CALENDAR

Nov 1 Columbus Computer Club will meet at the Center of Science and Industry at 7:30 P.M. For further information write c/o Fred Hatfield K8VDU, Computer Data Systems, 1372 Grandview Ave., Columbus, OH 43212, or call (614) 488-3347.

Nov 1 Kitchener Waterloo Microcomputer Club will meet at the University of Waterloo, Room 3388, Engineering Bldg. #4, University Ave., Waterloo, Ontario, Canada at 7:30 P.M.

Nov 1 Lincoln Computer Club will hold its meeting at the South Branch Library located on 27th and South Sts. at 7 P.M. For more details write Hubert Paulson, Jr., 422 Dale Dr., Lincoln, NE 68510.

Nov 1 New England Computer Society will meet in the cafeteria of the MITRE Corp. at 7:00 P.M. Located on Route 62 in Bedford, MA. Contact Dave Day at P.O. Box 198, Bedford, MA 01730, (603) 434-4239 for details.

Nov 1 The Valley Computer Club will meet at 7 P.M. at the Harvard School located at 3700 Coldwater Canyon, Studio City, CA.

Nov 2 Bay Area Microprocessors Users Group (BAMUG) will meet in the Hayward ROC Center, 26316 Hesperian Blvd., Hayward, CA at 7:30 P.M. For further details write BAMUG, 1211 Santa Clara Avenue, Alameda, CA 94501.

Nov 2 Microcomputer Users Group (MCG) will hold its meeting at the University of Minnesota, Electrical Eng. Rm. 115 at 7 P.M. The club meets every Thursday. For more information write MCG, Dept. of Elec. Eng., 123 Church St. S.E., Minneapolis, MN 55455.

Nov 2 Northwest Computer Society meets in the Pacific Science Center in Seattle, Room 200 at 7:30 P.M. The club also meets on the third Thursday of the month. For more details write NCCN, Box 4193, Seattle, WA 98055.

Nov 3 Crescent City Computer Club will hold its meeting at the University of New Orleans, Lakefront Campus at 8 P.M. Call Bob Latham at (504) 722-6321 for more details.

Nov 3 Microcomputer Information Group will meet at 7 P.M. at the Microcomputer Resource Center, 5150 Anton Dr., Rm. 212, Madison, WI 53719, (608) 274-8925. Len Lindsay, president.

Nov 4 Louisville Area Computer Club (LACE) will meet at the University of Louisville, Speed School

Auditorium at 1 P.M. For details, write the club at 115 Edgemont Dr., New Alban, IN 47150.

Nov 4 Milwaukee Area Computer Club will meet at 1 P.M. at the Waukesha County Technical Institute, New Berlin, WI. Call (414) 246-6634 for further details.

Nov 4 Oklahoma Computer Club will be meeting at the Belle Aisle Library at 10 A.M. Call Al Campbell at (405) 842-4933 for details.

Nov 4 South Central Kansas Amateur Computer Association, 9:00 A.M., Wichita Public Library, Wichita, KS. For further information call Chris Borger at (316) 265-1120 or Dave Rawson, 1825 Gary, Wichita, KS 67219, (316) 744-1629 for further details.

Nov 4 Southern Nevada Personal Computing Society will meet at Clark County Community College, Las Vegas, NV at 12:00. The club also meets on the 3rd Saturday of the month. For further information write SNPCS, 1405 Lucille St., Las Vegas, NV 89101 or call (702) 642-0212.

Nov 5 The Computer Hobbyist Group will meet at 1 P.M. in the Green Center, Rm 2.530, of Univ. of Texas, Dallas. For details write to P.O. Box 11344, Grand Prairie, TX 75051.

Nov 6 Amateur Radio Research and Development Corp. (AMRAD) meets the first Monday of each month at 8 P.M. at the Patrick Henry Branch Library, 101 Maple Ave. E, Vienna, VA. for details write the club at 1524 Springvale Ave., McLean, VA 22101.

Nov 6 Minnesota Computer Society will meet at the Brown Institute, Room 51, 3123 E. Lake Street, Minneapolis, MN. For further information contact the Society at Box 35317, Minneapolis, MN 55435, Attn: Jean Rice.

Nov 7 Tidewater Computer Club will meet at the Electronic Computer Programming Institute, Janaf Office Bldg., Janaf Shopping Center in Norfolk. The club also meets on the 3rd Tuesday of the month. For details contact: C. Dawson Yeomans, Interface Chairman, 677 Lord Dunmore Dr., Virginia Beach, VA 23462.

Nov 8 Home Computers Users Group for Radio Shack TRS-80 meets at 7:30 PM. For details write or call TRS-80 Users Group Information of Eastern Massachusetts, c/o Miller, 61 Lake Shore Road, Natick, MA 01760, (617) 653-6136.

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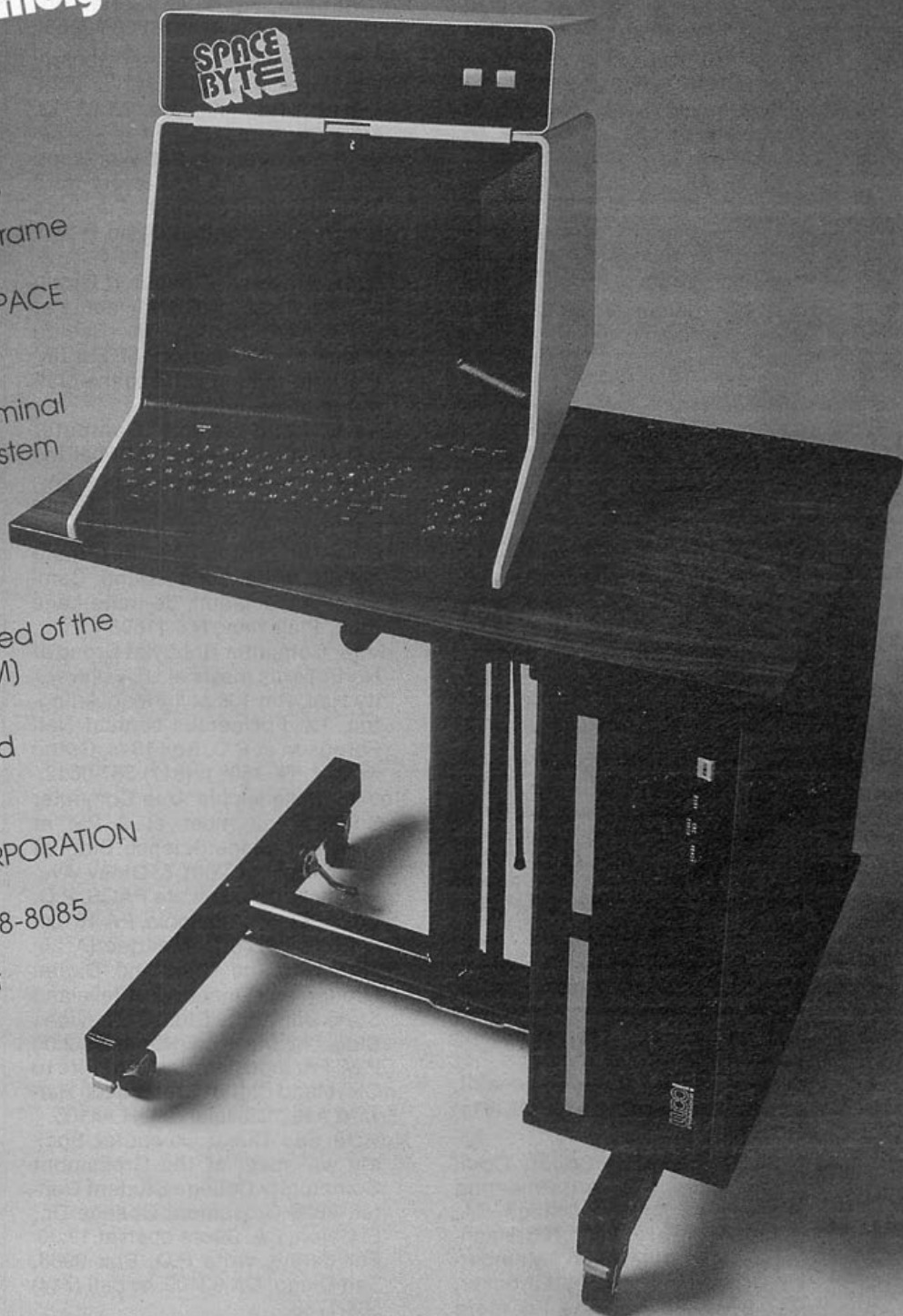
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## Virginia

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The Computer Place, Roanoke, VA

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Nov 8 Homebrew Computer Club meeting will begin at 7 P.M. in Menlo Park, CA at the Stanford Linear Accelerator Center Auditorium. Contact the club at P.O. Box 626, Mountain View, CA 94042, (415) 967-6754 for details.

Nov 8 Blackhawk Bit Burners Computer Club meets on the second Wednesday monthly at 7:15 PM in Rockford, IL. For more information contact Frank D. Dougherty, 325 Beacon Dr., Belvidere, IL 61008, (815) 544-5206.

Nov 9 Mid America Computer Hobbyist meeting will be at 7:00 P.M. at Commercial Federal Savings & Loan, Bellevue NE. Intersection of Galvin Rd. and U.S. Hwy. 73-75. Write P.O. Box 13303, Omaha, NE 68113 for further information.

Nov 9 North Florida Computer Society will meet at 227 Edison Dr., Pensacola, FL 32505. For details write this address or call Eugene Rhodes at (904) 453-3844.

Nov 9 The Rochester Area Microcomputer Society will meet at the RIT Campus, Rm. 1030, Bldg. 9 at 7:30 P.M. For details write RAMS, P.O. Box D, Rochester, NY 14609.

Nov 9 Utah Computer Association will meet at Murray High School, Rm 154, 5440 S. State St., Salt Lake City, UT at 7 P.M. For details write or call Larry or Holly Barney, 1928 S. 2600 E., Salt Lake City, UT 84108. (801) 485-3476.

Nov 10 HAUC will meet at 7:30 PM in Rm 117 of the Science & Research Bldg. of the main campus of the Univ. of Houston. For more details write or call P.O. Box 37201, Houston, TX 77036, (713) 661-6806.

Nov 10 Northern New Jersey Amateur Computer Club (NNJACC) will hold its meeting at the Fairleigh Dickenson University, on the Rutherford Campus, Becton Hall, Room B8, at 7 P.M. For details write NNJACC, 593 New York Ave., Lyndhurst, NJ 07071.

Nov 11 The Permian Basin Computer Group — Odessa Chapter meets at 1 P.M. in the Electronic Technology Bldg., Room 203 on the Odessa College campus. For details contact John Rabenaldt, Box 3912, Odessa, TX 79760, (915) 332-9151.

Nov 12 North Orange County Computer Club will have its meeting at Chapman College, Orange, CA. Doors open at 12:00. 105 Hashinger Hall Auditorium. Membership Chairman, Tracey Lerocker, (714) 998-8080 evenings. For more

information write P.O. Box 3603, Orange, CA 92655.

Nov 14 Okaloosa Computer Hobbyist Club will meet in the Community Room of the First Federal Savings & Loan Assoc. of Okaloosa County, 158 Elgin Pkwy N.E., Ft. Walton Beach, FL at 7 P.M. For details call (904) 242-5938.

Nov 14 Rome Area Computer Enthusiasts (RACE) meets on the second Tuesday of every month at Patty's Stagecoach Inn at 7:30 P.M. For details contact Mike Troutman, RD 1, W. Carter Rd., Rome, NY 13440, (315) 336-0986.

Nov 16 Madison Computer Society will meet at 7:30 P.M. at 2707 McDivitt Rd., Madison, WI 53713. Mike Shoh, president.

Nov 16 Sacramento Pet Workshop meets from 7-10 P.M. every third Thursday of the month. For more information contact David Howe, (916) 445-7926.

Nov 17 Amateur Computer Group of New Jersey (ACGNJ) meets at UCTI, 1776 Raritan Rd., Scotch Plains, NJ 07076 at 7 P.M. For further information write to the club at the above address.

Nov 17 Long Island Computer Association meets at 7 PM at the New York Institute of Technology, Old Westbury Campus, Route 25A between Route 107 and Glen Cove Rd., Rm. 508. For more details write Long Island Computer Association, 36 Irene Lane East, Plainview, NY 11803.

Nov 18 Computer Hobbyist Group of North Texas meets at UTA University Hall, Rm 108 at 1 PM in Arlington, TX. For details contact Neil Ferguson at P.O. Box 1344, Grand Prairie, TX 75051, (817) 387-0612.

Nov 18 Philadelphia Area Computer Society will meet at 2 PM at LaSalle College Science Bldg. at the corner of 20th & Olney Ave. For more details write PACS, P.O. Box 1954, Philadelphia, PA 19105.

Nov 18 The 7C's Committee (Affiliated with the Cleveland Digital Group) will meet at Cleveland State University Student Services Bldg., in the Kiva Room at 2:00 P.M. For more information write to Cleveland Digital Group, 8700 Harvard Ave., Cleveland, OH 44105.

Nov 18 San Diego Computer Society will meet at the Grossmont Community College Student Center, 8800 Grossmont College Dr., El Cajon, CA. Doors open at 12:30. For details write P.O. Box 9988, San Diego, CA 92109, or call (714) 565-1738.



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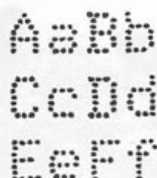
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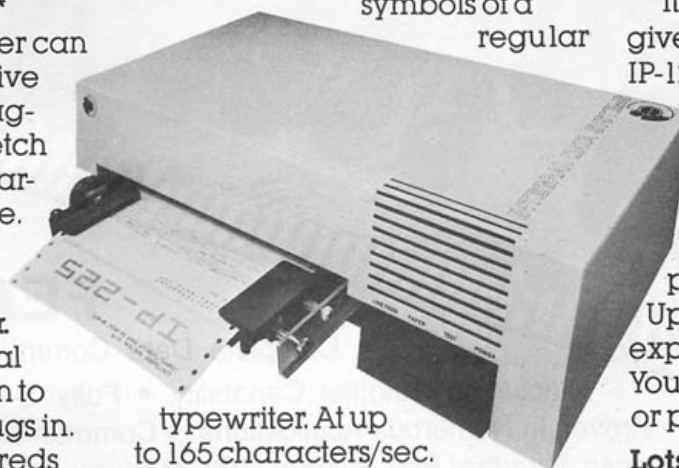
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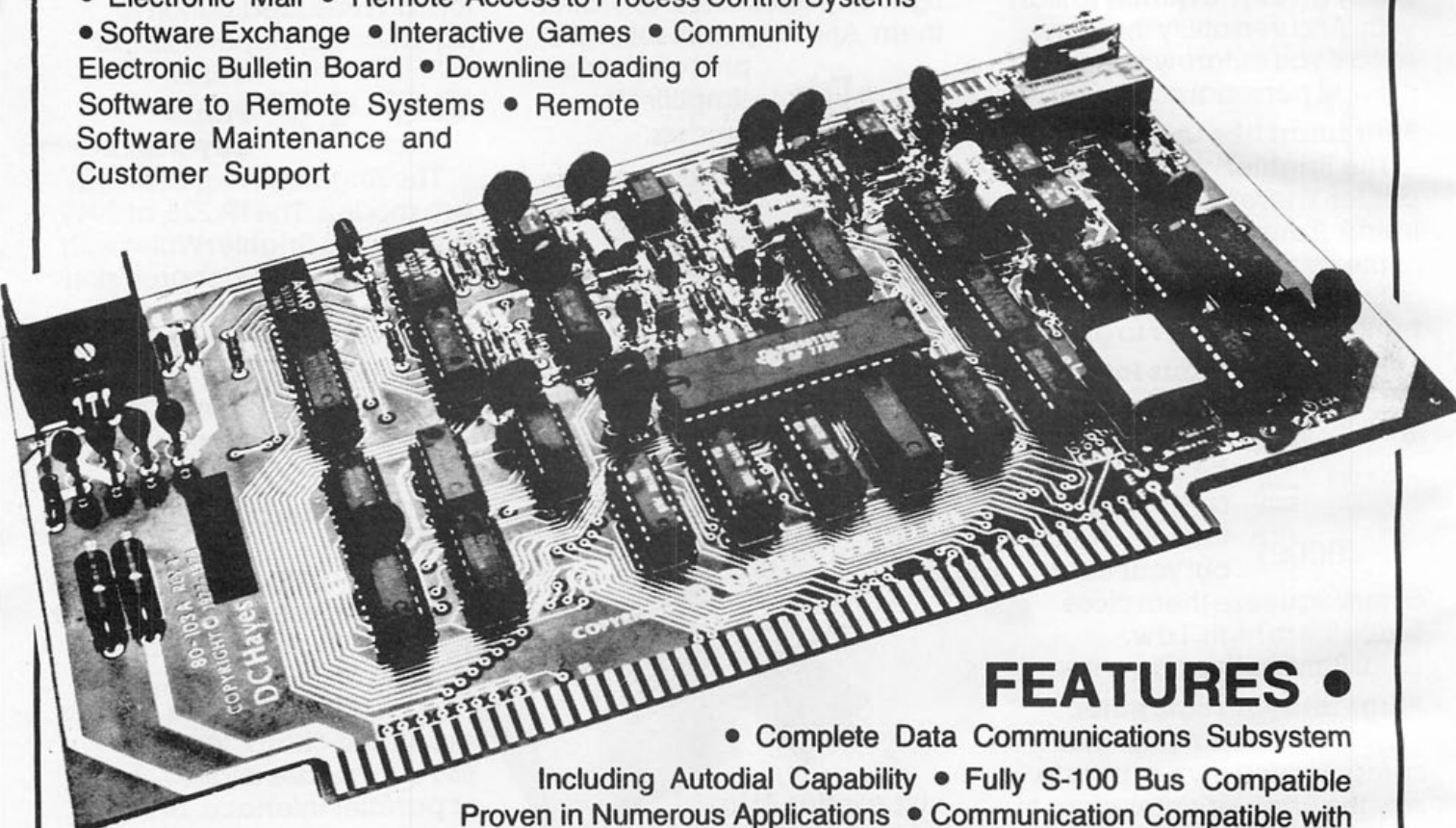
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**modem** / 'mo • dəm / [modulator + demodulator] *n* - *s* : a device for transmission of digital information via an analog channel such as a telephone circuit.

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Nov 19 Central Florida Computer Club will meet at 2010 Fosgate Dr., Winter Park, FL 32789 2:00 PM. Contact Bill Kerns for details.

Nov 19 Cleveland Digital Group meets at 2 P.M. in the old railroad station at Safier's Inc., 8700 Harvard Ave., Cleveland, OH 44105. Write the club at this address for more information.

Nov 21 Rhode Island Computer Hobbyists (RICH) meets at the Knight Campus of Rhode Island Junior College in the Faculty Cafeteria at 7:30 P.M. For details contact Emilio Iannucillo, RICH, P.O. Box 559, Bristol, RI 02809, or call (401) 253-5450.

Nov 22 Ventura County Computer Society will meet at Camarillo Public Library, 3100 Ponderosa Dr., Port Hueneme, CA 93041 at 7:30 P.M. For more information write: VCCS, P.O. Box 525, Port Hueneme, CA 93041.

Nov 22 Diablo Professional Users Group (DPUG) will meet at Diablo Valley College Library, near the Willow Pass exit of Fwy. 680, from 8-10 PM. For details write or call Bob Hendrickson, Electronics Dept., DVC, Pleasant Hill, CA 94523; (415) 687-8373.

Nov 22 Boston Computer Society will meet at the Commonwealth School, 151 Commonwealth Ave., Boston at 7 P.M. The school is located on the corner of Dartmouth St. in Boston's Back Bay. For information write or call the society at 17 Chestnut St., Boston, MA 02108, (617) 227-1399.

Nov 24 Alamo Computer Enthusiast meets at 7:30 PM in Rm 104 at Chapman Graduate Center at Trinity University, San Antonio, TX. For details call (512) 532-2340, or write to the club at 7517 Jonquill, San Antonio, TX 78233.

Nov 24 Washington Amateur Computer Society will meet at the Catholic University of America, St. Johns Hall, located at Michigan and Harewood Aves. in Washington, D.C. Contact Bill Stewart at (202) 722-0210 for club details between the hours of 10 A.M. and 12 P.M.

Nov 26 Birmingham Microprocessor Group will meet at Southcentral Bell Company headquarters bldg. at 2 P.M. For further details

write or call Jim Anderson, 2931 Balmoral Rd., Birmingham, AL 35223; (205) 897-9630.

Nov 26 Summit City Computer Club will meet at the McMillen Library on the Indiana Institute of Technology Campus in Ft. Wayne, IN. For details write the club at P.O. Box 5096, Ft. Wayne, IN 46805.

Nov 28 Southern California Users of RT-11 (SCURT) will meet at 9:30 AM at USC's Annenberg School of Communications. For details call Mark Bartelt, (213) 795-6811, ext. 2663; or Ray Rittenhouse, (213) 640-1830, ext. 225.

Nov 28 Computer Amateurs of So. Jersey will hold its meeting at the National Park Municipal Bldg., 7 So. Grove Ave., National Park, NJ at 7:30 P.M. For details call (609) 541-1010, or (609) 541-8296.

Nov 28 Sacramento Microcomputer Users Group, (SMUG), 7:30-9:30 P.M. at SMUD Training Bldg., on 59 St. Write Richard Lerseth, P.O. Box 161513 or call (916) 381-0335 after 5:00 P.M.

Nov 28 Okaloosa Computer Hobbyist Club will meet in the Santa Rosa Rm, in the Santa Rosa Mall, Mary Esther, FL at 7 P.M. For details call (904) 242-5938.

Nov 28 The Digital Group Group meets the last Tuesday of each month in the meeting room of Consumer Systems at 2107 Swift Rd., Oak Brook, IL at 7:30 PM. For more information write the group c/o William L. Colsher, 4328 Nutmeg Ln., Apt. 111, Lisle, IL 60532.

Nov 28 The Apple Portland Program Library Exchange (APPLE) meets on the last Tuesday of each month at 7:30 PM. For location and details contact Ken Hoggatt, 9195 SW Elrose Ct., Tigard, OR 97223, (503) 639-5505 or (503) 644-0161, Ext. 6136.

Nov 29 The National Capitol Chapter of the Tandy Computer Users Group meets on the last Wednesday of each month. For details contact Rod Wright, 8205 Chivalry Rd., Annandale, VA 22003, (703) 560-5854.

Nov 30 Small Computer Engineering Association of Minnesota (SCEAM) will meet at the Resource Access Center, 3010 Fourth Ave. So., Minneapolis, MN 55408 at 7 P.M. For more information write to this address or call (612) 824-6406.

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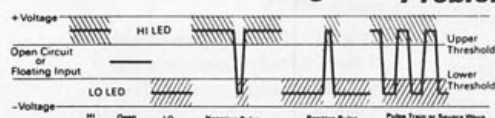
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# WHITE COLLAR MICROCOMPUTER

By James S. White

This month's INTERFACE AGE is dedicated to hardware — how you might select your first computer. Various articles discuss topics such as your objectives for using a computer and the equipment necessary to meet these objectives.

Planning for the future is important in selecting and preparing for a computer, at least as important as is planning for other business management functions. Plans are the tracks on which a business runs. A business without plans cannot control its progress any more than can a train off its tracks.

Plans for computer selection and use should support and otherwise be consistent with business plans. Similarly, business plans should include consideration of a computer, what it will require of an organization, and its effects on the organization.

## PLAN FOR GROWTH

Planning for the future of computer use is almost always planning for growth. Businesses themselves generally grow, and the growth of a business means growth in the power of the resources, particularly computers, which it needs to operate.

Another factor promoting the growth of computer use is the frequent discovery of new and different additional ways to use the computer. Computers can help in many ways, and success in one application provides a good basis for natural implementation of other computer applications.

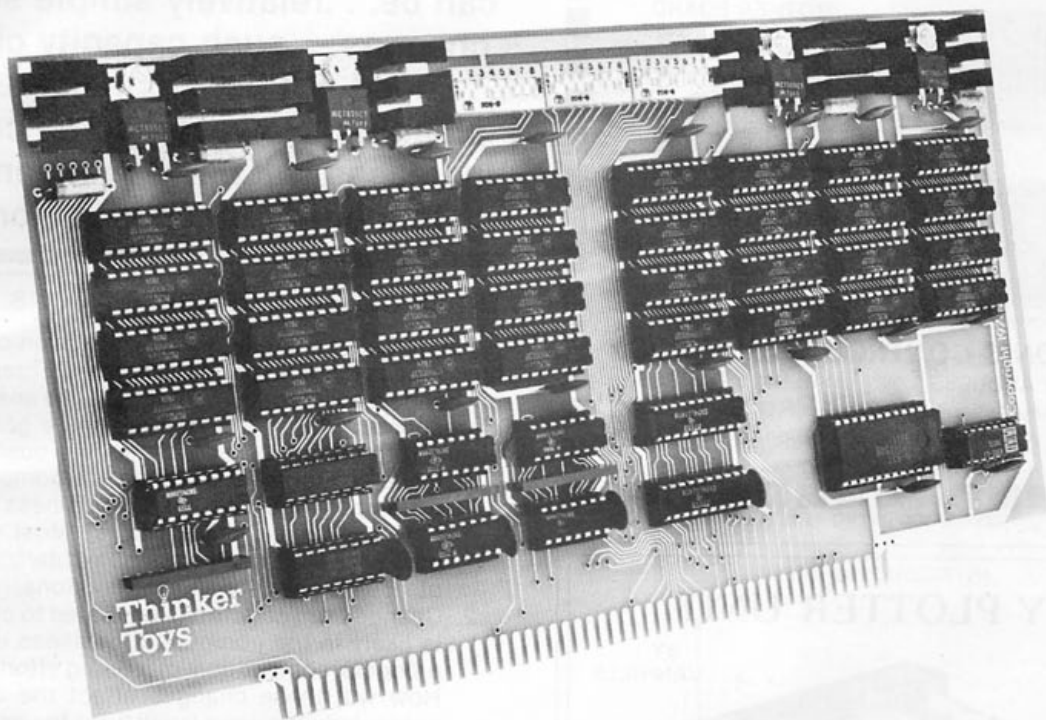
Finally, the rapidly increasing capacity and decreasing cost of small computer hardware and software are strong independent factors supporting increases in computer use. The computer is chosen as a tool because it is less expensive than alternatives. As most costs are rising while computer costs are falling, computers are becoming the best solution in more and more applications.

Negative factors influencing growth of computer use are seldom present and even less often significant. An organization may decrease its use of a purchased or leased computer. However, rarely will an organization get a smaller computer just because of unused capacity. The cost of changing to less powerful equipment is generally a greater expense than the resulting savings. Similarly, if one finds that a program has excess capacity, the most cost-effective solution is to leave it unused. Changing programs in such circumstances is rather expensive and rarely results in useful savings.

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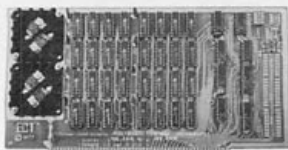
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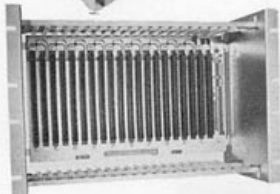
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CIRCLE INQUIRY NO. 18

The impracticality of decreasing computer costs may be frustrating, but it is realistic. Perhaps this restriction would become more acceptable if it were considered as similar to the inflexibility of other semi-fixed equipment costs. Very often, the rule "what goes up must come down" just doesn't apply in practical economics, at least for periods of only a few years.

Recognition of the difficulty of cutting costs may promote skimping on initial computer investments. This, of course, is as unwise as splurging. The proper solution is to plan for needs and opportunities and to plan the most cost-effective method of meeting these needs and benefiting from these opportunities.

**...needed increases in capacity  
can be. . .relatively simple software  
changes. . .such capacity changes  
need not be. . .considered in  
planning. However, some capacity  
increases will be very expensive. . .  
to identify these is important.**

### THREE GENERAL CONSIDERATIONS

Planning is generally the consideration of change — how to cause and respond to changes. Three categories of change may affect computer use. The answer to three corresponding questions can provide a good basis for planning the future of a computer in a business.

1. If the environment in which the computer is used doesn't change, how will the business' use of computers increase in the future? Most often, these new uses will result from computerizing the more obvious present business functions.
2. Change from conditions unrelated to computer use is likely in the computer's business environment; products, competition, marketing efforts all change. How will these changes affect the organization, particularly the ways it will want to use computers?
3. How should computers be used to change the computer's business environment? For example, in a distribution function a computer might be selected as an order entry tool, allowing better entry of orders and convincing the company to aggressively seek small orders which were previously unprofitable. Or a computer might allow computer-supported, exceptionally quick service be the basis for its advertised marketing image.

### REASONS FOR CAPACITY INCREASES

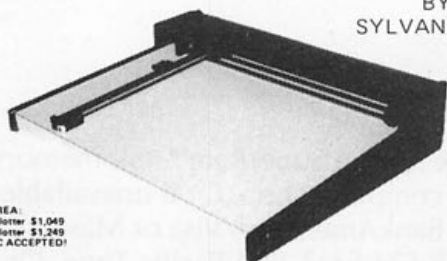
The need for increases in installed computer capacity can result from several types of factors specifically related to how computers are used. Following are the most common.

First is the need to increase the capacity of the basic functions which the computer is performing. Examples might be a business adding products or departments, thus exceeding the number of products or departments which the computer hardware and/or software could handle. In other cases, there may be limits on the number of orders, customers or employees which can be handled.

Often such needed increases in capacity can be accomplished by relatively simple software changes. Therefore, most such capacity changes need not be specifically considered in planning. However, some capacity increases will be very expensive to implement, and planning to identify these is important.

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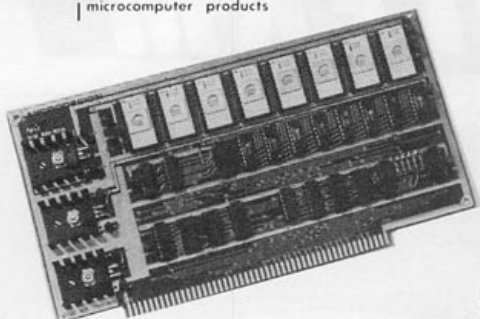


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Another reason for capacity increase is the need or desire to use a commercially available software product. Acquiring already programmed software is often much less expensive than writing one's own. However, the software which someone else has written generally is for a computer with features and accessories at least a little different than yours. Therefore, you must add the features the software needs that you don't have.

One may also feel that the computer, or a part of it, is too slow. This reason is often more emotional than rational because there are many ways to compensate for slow computers, ways that often are much less expensive than increasing capacity. Frequently, the slowness is no real problem at all. In any case, planning can help one anticipate the conditions calling for speed increases as well as the time when the need for computer growth may occur.

A more important reason for increasing capacity is the need or desire to do more with one's computer. Having the computer automatically handle more of the manual exceptions required in a computerized system is obviously advantageous, but this type of increase often requires surprising amounts of resources. Allowing more flexibility and more ways to use existing programs is a similar reason for capacity increase. These last two are especially significant to consider when planning because they commonly result from neglecting to include features in early programs which were initially considered unnecessary, but which users later decide they "can't live without".

Consideration of these preceding reasons can be a worthwhile part of computer planning and yield good results.

**WAYS COMPUTERS GROW**

What effect on a computer does the need to grow have? One way a computer grows is by adding more memory capacity. More memory will allow larger, more powerful programs as well as the ability to handle more data such as a larger number of customers or employees. Memory capacity can be in RAM or magnetic media such as floppy disks, cassettes, or tape cartridges.

Adding the needed amount of memory can range from easy and inexpensive to impossible. Often a certain amount of memory can be added relatively easily. However, once the normal memory size limit of a particular computer has been reached, further increases are unusually much more expensive. Determining and considering the practical limitations of the computer under consideration can be an important basis for planning.

The other major way of increasing computer hardware capacity is by adding peripheral components. Sometimes the added peripherals can be replacements, perhaps to increase speed. Often they provide totally new functions. Will you want to add voice input or output capability to your computer? Will you want to add on-line controllers, perhaps so your computer can turn on or off a motor? If so, you can benefit from choosing a computer to which such capability can be added with reasonable ease and expense.

**PLAN FOR LEARNING**

Computer planning is harder than most types of planning, for two reasons. First, the basic technology of computers is changing so rapidly that detailed long range plans are totally unrealistic. The second reason is the great and unimaginable effect that computers can have on your business.

But planning is still possible and vital. A basic premise for the prospective new user's planning is that the first computer will be largely a learning experience. True, one

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should expect useful results of direct benefit to one's business, and proper planning will ensure such benefits. However, a computer is so different a tool and will have such unanticipated effects on your organization, the best thing to do is to try one and then make fairly specific future plans based on the results of your early experience.

### CAVEATS

1. When considering a computer system, ask the vendor about the availability and cost of expansion features you may need. Also try to evaluate whether such features may be unavailable when you need them, perhaps because the manufacturer is no longer in business or because he has dropped the feature from his product line.
2. Generally, a doubling of the power of an installed computer is a reasonable plan. Greater increases are often best accomplished by changing to a larger computer. As with any other type of machine, a computer to which too many accessories have been added becomes unwieldy and awkward.
3. As is now obvious, don't buy the top-of-the-line, a computer which can't be expanded, unless you can confidently assume there will be no need to increase capability.
4. Plan ahead, but not too far. About three years is often a reasonable time period: not so far that conditions are unforeseeable, but long enough to allow the first computer to be learned from and proper planning to be done for a second system.
5. Many component manufacturers and equipment vendors will expand their product lines in the future and thus allow the owner of a computer to upgrade his system more than is possible today. However, the buyer who bases his plan on any future additions to product lines is gambling. □

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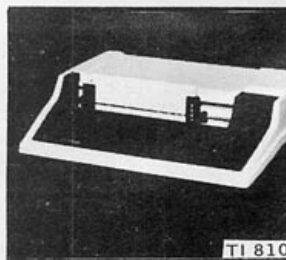
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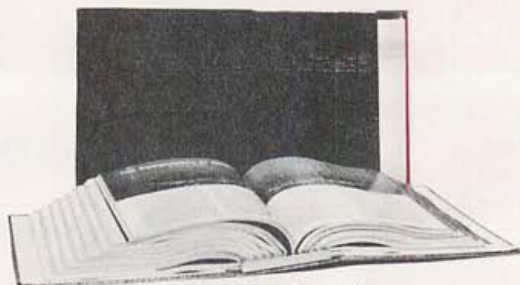
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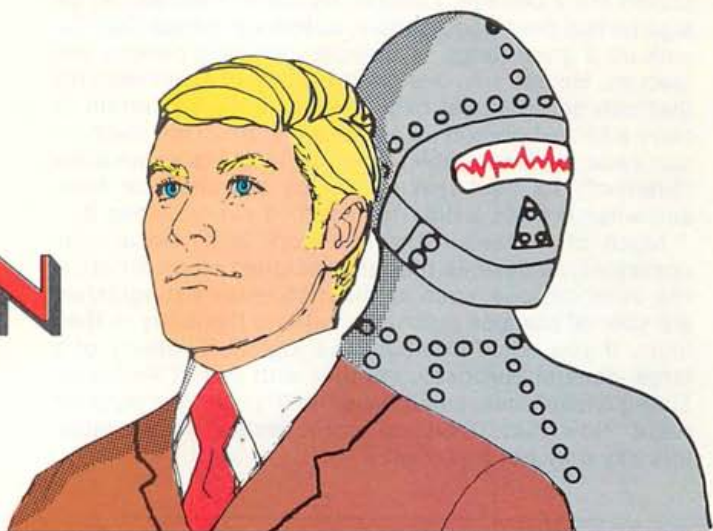
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# THE MIND REVOLUTION

By Merl Miller



Last month we started a commentary on robot history that ended with the Hopkins Beast. If you haven't read last month's column yet, you may want to now. This month I would like to continue the discussion.

As a result of the atomic energy research carried on in the 1950's, elaborate mechanical arms were developed to handle radioactive materials. They were usually controlled by an operator who was behind a glass shield, some distance from the radioactive material. As the research in this area progressed, the arms became increasingly more sophisticated so that by the early 60's they could be controlled remotely by a closed circuit television system.

A great number of computer scientists began to wonder if these arms could be controlled by a computer. Henry Earnst of MIT was one of the few computer scientists able to obtain one of these mechanical arm devices. He first discovered that the arms were quite agile. They could easily perform fairly complicated functions such as screwing in a light bulb or striking a match, but only if the person operating the machine had his eyes open. If the operator tried to control the arms with closed eyes, little could be accomplished. This meant that if a computer were linked to the machine, it would have to have

some "seeing" capability. This was a formidable task. At this time the Hopkins Beast was the most advanced "seeing" robot, and all it could do was "see" an electrical outlet under certain conditions. In addition, pattern recognition was in its infancy.

Dr. Earnst couldn't teach his computer to see so he taught it to "feel". He devised a series of sensors that enabled the arm to feed information back to the computer. Every joint had pressure pads that sensed when the arm touched something, and a series of photoelectric cells helped it distinguish light objects from dark objects. Even with these aids, it could still only fumble a bit. Its most significant accomplishment was a table clearing routine. The arm would systematically sweep back and forth across the table until it bumped into something. When this happened it would try to pick up the object, carry it to the edge of the table and drop it into a bin.

Dr. Earnst's studies showed that although a computer could learn to interact with its environment, it needed a mechanical device specifically designed for computers. It seemed unfeasible to adapt a computer to an already existing machine. Consequently, in the years following the development of Earnst's machine, scientists began putting together complete robot systems that weren't dependent on man being in the loop.

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In addition to Dr. Earnst, the most interesting of the modern-day robotic pioneers is Dr. Meredith Thring, head of the Department of Mechanical Engineering at Queen Mary College, London. By clever mechanical design he has developed simple, automatic hands that can pick up a great range of objects including pencils and teacups. He has also designed a group of small vehicles that can safely travel over level or irregular terrain or carry a seated person up and down stairs. One machine can clear a dinner table. Another is quite an amateur "fireman". Its heat-seeking device searches for heat, and when it finds a fire, the machine extinguishes it.

Much of Professor Thring's work is aimed at tele-operator-type devices that are designed as prosthetics. His other devices, such as the mobile fire extinguisher, are special purpose machines with no flexibility in their logic. If you could combine the logical flexibility of a large, general purpose computer with one of Professor Thring's machines, you'd have the first general purpose robot. Now that 16-bit microprocessors are available, this day may not be far off.

I have another thought to share with you. Dave Morris is a computer, electronics and robotics hobbyist in Dallas, Texas. He has a couple years of college and would someday like to get a B.S. in computer science.

I had a very interesting conversation with Dave when I called regarding a letter he wrote to Carl Warren. The letter concerned my July column. What follows is an adaptation of his letter and our conversation, interspersed with some of my comments:

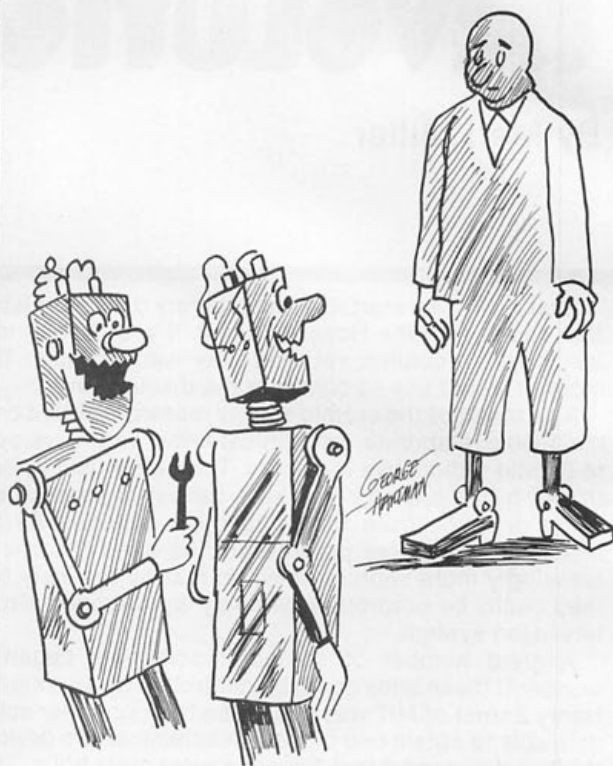
"What if we designed a robot that could drive your car?" That is the question I posed in the July column. The first real problem is how the system differentiates. It will need to recognize a traffic light in the midst of thousands of flashing neon signs, taillights, headlights, turn signals, street lights, store illuminations, light reflections and all the other hundreds of confusing light sources found on a typical city street at night.

The system would also need to estimate human behavior. For example, it would have to decide whether or not a car racing toward your intersection from a side street is going to stop in time. The system will have to look ahead far enough to tell

that the weaving car in front of you is, in fact, not avoiding traffic but doing so because the driver is drunk.

Will the system slam on the brakes in the event of emergency or slow for a tumbleweed, paper boxes, dogs or children? And how will we program it to know the difference?

These are all interesting questions and point to the necessity of thinking through all projects. □



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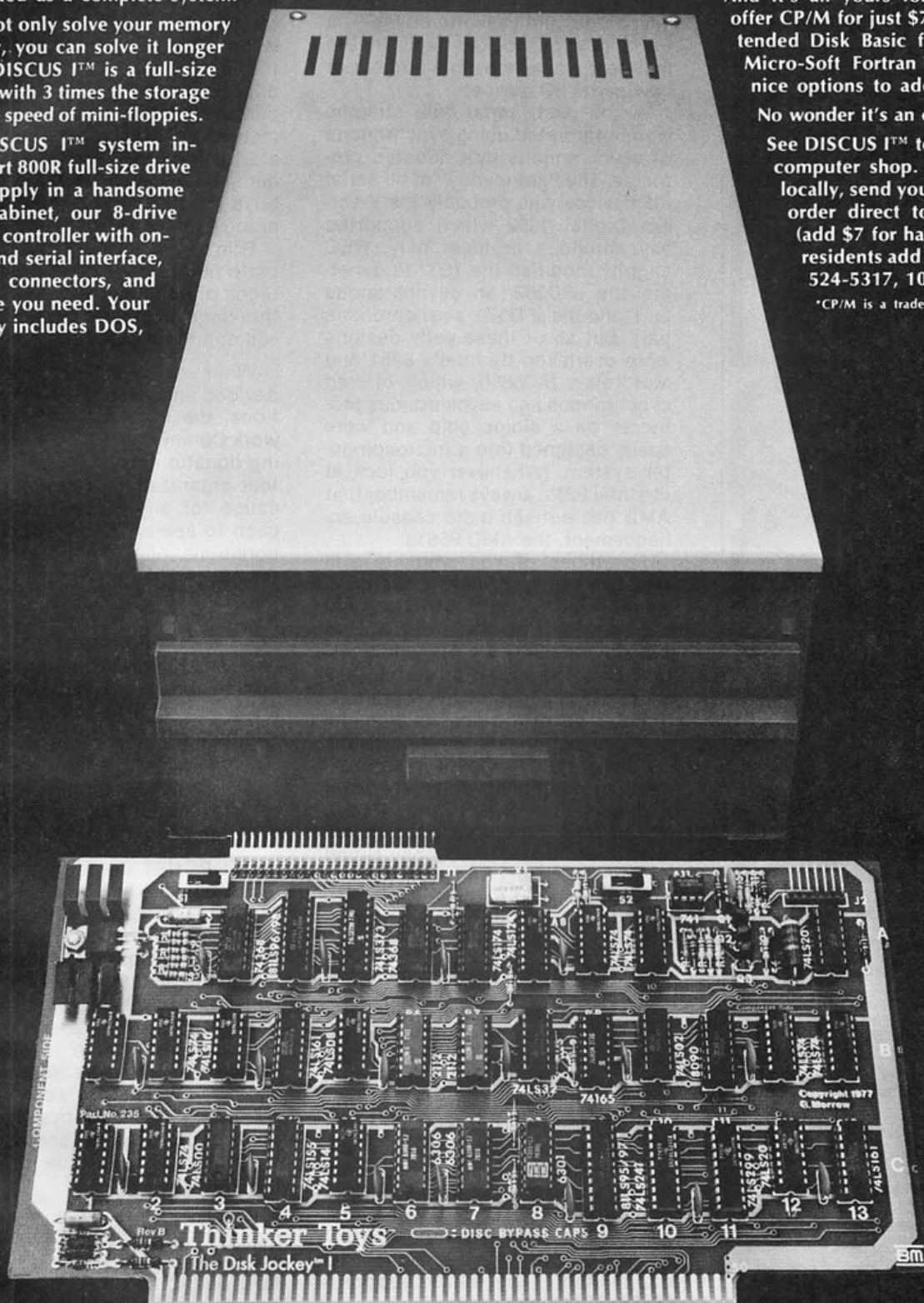
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# FROM THE FOUNTAINHEAD

By Adam Osborne

I believe that **serial input/output devices and serial input/output capabilities** will become increasingly more important as telephone communications between microcomputer systems becomes more commonplace. Also, serial I/O devices make very inexpensive controllers for low-speed peripherals such as printers, keyboards, and cassette drives — a frequently overlooked fact. In the last year we have seen a number of new serial I/O devices.

In the past, serial data streams were interpreted using synchronous or asynchronous byte-oriented protocols. The "granddaddy" of all serial I/O devices was probably the Western Digital 1602 which supported asynchronous protocol only. NEC slightly modified the 1602 to generate the  $\mu$ PD369, an asynchronous part, and the  $\mu$ PD379, a synchronous part. But all of these early designs were overtaken by Intel's 8251 and Motorola's MC6850, which offered synchronous and asynchronous protocols on a single chip and were easily designed into a microcomputer system. (Whenever you look at the Intel 8251, always remember that AMD has a much more capable enhancement, the AMD 9551.)

For those of you who are still primarily using asynchronous communications protocol, National Semiconductor's new 8250 ACE is probably the ultimate asynchronous-only part. The 8250 is powerful, easy to interface and easy to program.

For those of you who are primarily using synchronous protocols, the old byte-oriented monosync and bisync protocols have largely been displaced by SDLC and HDLC. These are bit-oriented protocols with a whole new philosophy aimed at increased throughput. Many new synchronous serial I/O parts are available, some of them supporting SDLC only while others support SDLC together with earlier synchronous protocols.

Zilog's Z80-SIO device was the first multi-protocol part to be announced. Unfortunately, the Z80-SIO device still has a few minor "features" which you have to design around; however, it offers two serial I/O channels with asynchronous, synchronous and SDLC protocols all on a single chip. Intel's 8273 is primarily an SDLC part with more SDLC capabilities than the Z80-SIO device but very limited non-SDLC capabilities. The 8273 supports IBM's SDLC loop mode.

A trio of very similar parts are the Fairchild F3846, the Signetics 2652 and the Motorola MC6854. These three parts appear to have been heavily influenced by the same de-

sign concepts. All three support SDLC and HDLC protocols, plus (to varying degrees) synchronous byte-oriented protocols. The capabilities of these three parts are, as we might expect, in order of their appearance: the Fairchild 3846 is the most recent and probably the most powerful, the MC6854 comes in the middle, and the Signetics 2652, being the oldest, is possibly the most error-free but the least versatile. The 3846 is the only device with complete and accurate IBM bisync protocol, implemented in chip logic. Before you start using the newest part, remember my well-known warning: "He who buys on the cutting edge of technology shall be sacrificed upon it."

Don't rush into using brand new parts before considering the advantages of using something that is on the verge of becoming obsolete. It will spring no surprises on you.

While on the subject of serial I/O devices and telephone communications, the **Personal Computer Network Committee (PCNET)** are soliciting donations (as a non-profit volunteer organization). Here is a worthy cause for any of you with a little cash to spare. They are looking for donations of \$100 for a retaining member, \$250 for a sustaining member, \$500 for a sponsoring member, and \$1,000 for a philanthropic member. I realize most hobbyists do not have enough money to buy the RAM boards they need, but surely there are a few who can help PCNET. If you can, write to:

Personal Computer Network  
(PCNET) Committee  
701 Welsh Road, Suite 226  
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The PCNET Committee's project is possibly the most significant contribution to personal computing that I have seen in the last 12 months. By making available data bases and telephone communications at reasonable cost, they greatly enhance the usefulness of every personal computer. But there is one more reason why I really wish PCNET well: I would like to see them get solidly established with a single protocol before we are faced with ten different incompatible networks that confuse everyone.

I received a letter from Mr. Raymond M. Glueck, singing the praises of **KEA-Microdesign**, their GRAPHIC-ADD board, and the attitude of Mr. Ken Anderson (who is KEA-Microdesign). Mr. Glueck states that he is chief engineer with a large chemical company, which makes his comments all the more meaningful. It is very rare that someone takes the

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## FROM THE FOUNTAINHEAD

Vectored from previous page

time to write spelling out the good deeds of a vendor; usually they write only to complain. But if KEA-Microdesign is really doing the job that Mr. Glueck suggests, this company should definitely be brought to the attention of all microcomputer users. I would like to solicit comments from KEA-Microdesign customers in particular and comments about the "good guy" companies in general. I have had a flood of critical letters aimed at most manufacturers in the business, and I know that this represents a one-sided sampling. Would you please take the time to write and tell me about the good guys, so that I can publicize their good deeds? Write to me directly at:

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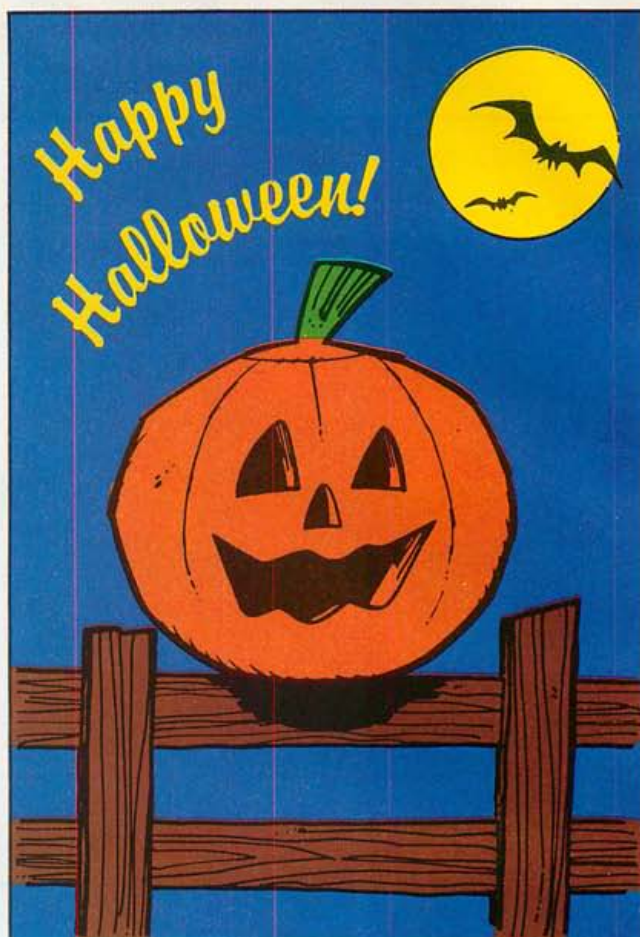
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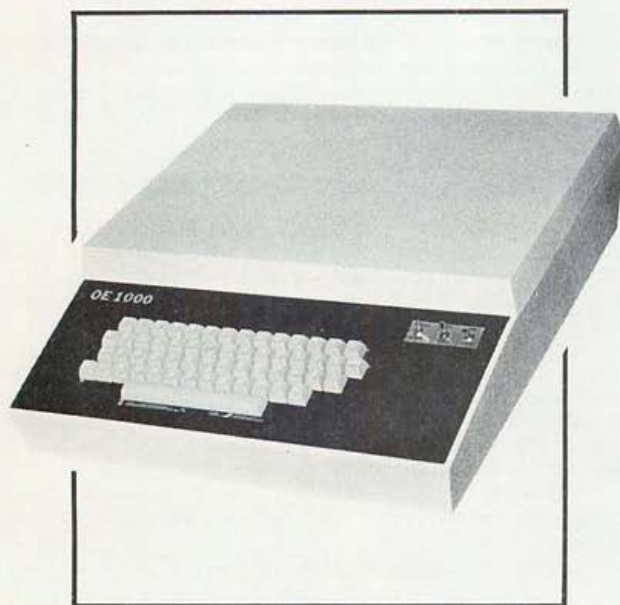
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I received another interesting letter from Database Computer Systems, P.O. Box 33, Kurait-ONO, Israel.

This company has put together a Technico TMS9900 system for which they are busy generating software. Those of you who may be interested in obtaining **Technico software** should write to Bob Alenco, at Database Computer Systems. □



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## A SYSTEM FOR THREE-DIMENSIONAL GRAPHICS DISPLAY

I have always been fascinated by the idea of three-dimensional television. Unfortunately, most attempts have involved special glasses worn by the observer, and the viewer only gets one perspective of the televised image. He looks at a flat screen, and if he walks around the back of it, he sees the back side of a TV set, not the back side of the image. Holography (laser photography) may hold some hope for the future but does not appear feasible at present. I believe, however, that I have an idea for developing a true three-dimensional system that hobbyists could experiment with.

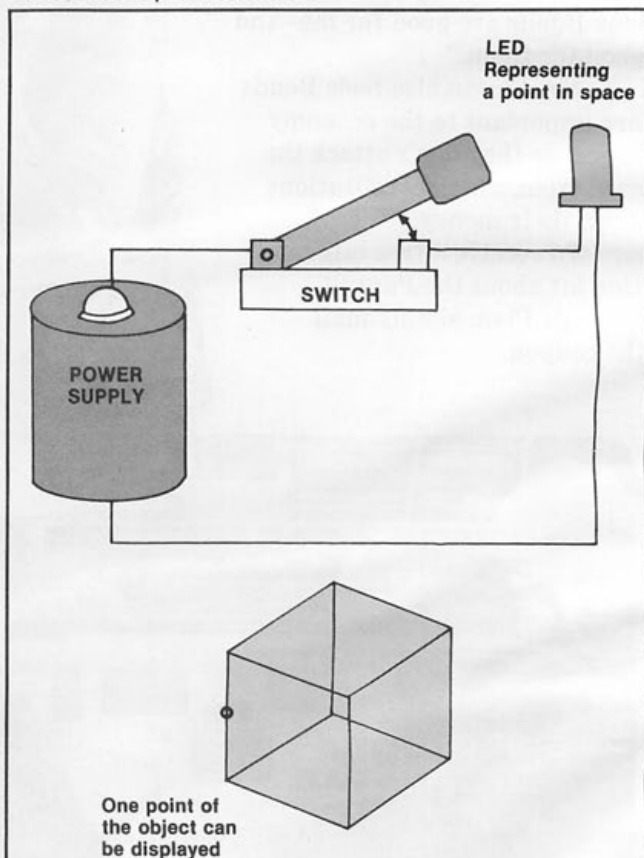


Figure 1. If the selected point in space (represented by the LED) corresponds to some part of the 3-D object, then the LED is turned on, otherwise it is turned off.

Suppose we take a simple LED (light emitting diode) with a power supply and an on-off switch. We mount the LED at some arbitrary point in space. We can then represent a point in space by turning the LED on or the absence of that point in space by turning it off.

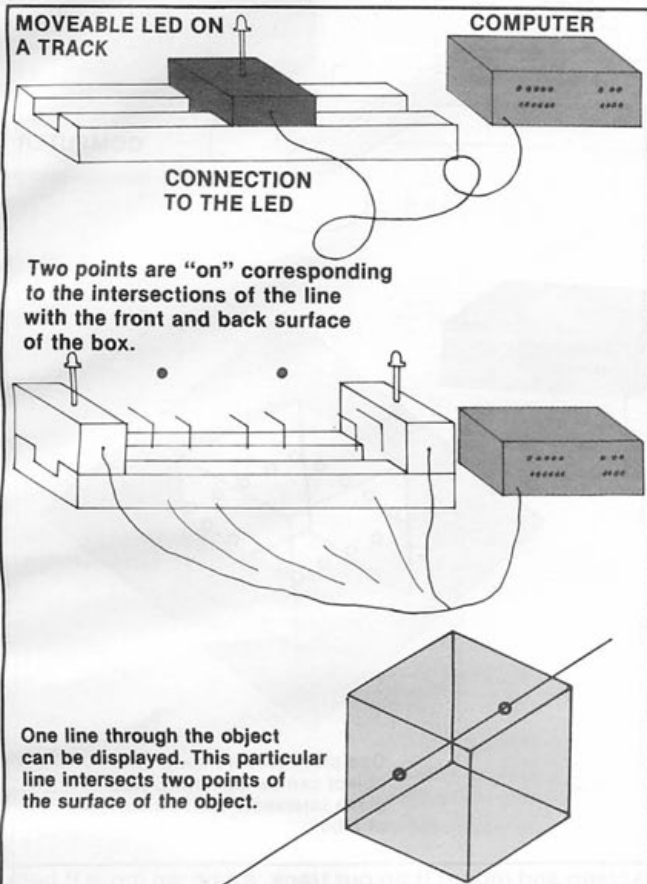


Figure 2. The LED on the track is moved quickly back and forth. The computer turns the LED on and off at appropriate points along the track. It "sweeps out" and displays a line in space. The LED is on where the line intersects a surface of the 3-D object and off otherwise. If you move the box the points on the line move correspondingly.

Next, we mount the LED on a movable track so that it can be moved quickly back and forth in a linear fashion. Let's say the range of movement is twenty inches. Instead of a manual switch to turn the LED on and off, we control it with a computer. The computer is set up so that it knows the exact position of the LED along its path at any given moment. We can then store information representing any set of points and line segments into the memory of the computer and, with proper programming, have the computer display those points and lines by turning the LED on and off at the appropriate times as it (the LED) moves along the track. By moving the LED back and forth along its track at a rate of sixty times a second, the human eye does not have time to perceive the individual positions so it sees it as a line or a point. The computer could even make the points and lines appear to move.

For the next step in the development of our system, we substitute a linear array of LEDs mounted on a track which moves the array so that it "sweeps out" a plane of space rather than a simple line in space. Again, each LED is under computer control, and the computer knows the position of the array at any given moment. We store into the computer memory information representing a slice of space, say twenty inches by twenty inches. If, for example, it represented a simple plane through an

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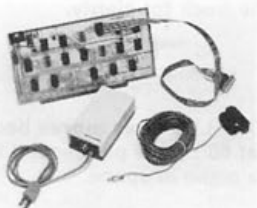
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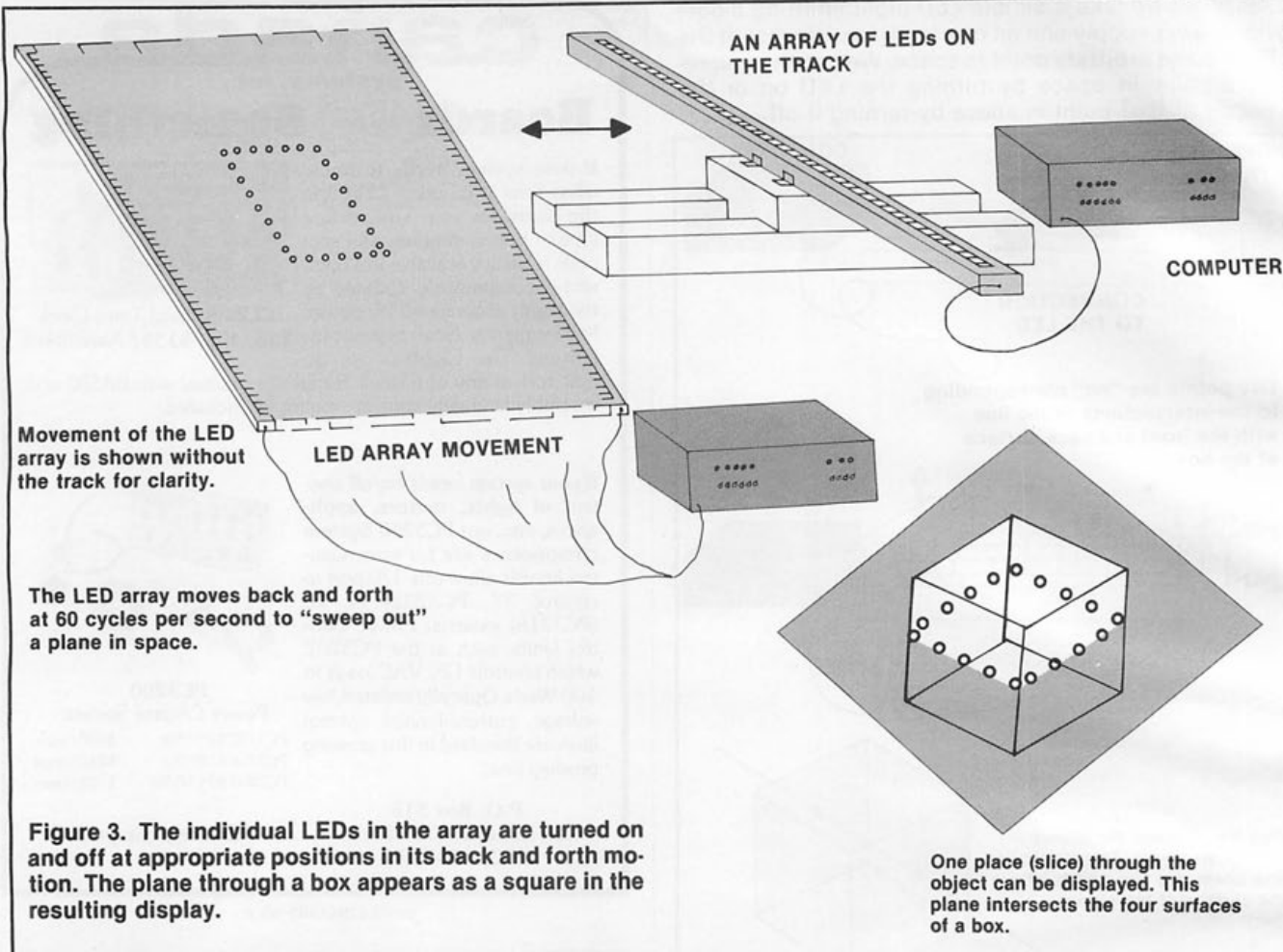
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empty box, then the information might be a square, and the computer could display it by appropriate control of the LEDs in the array. Just as the points and lines could be made to move in one dimension in the previous setup, the plane figures in this setup could be made to move in two dimensions. It would have the general appearance of a common television set.

Now let's extend the idea further. Suppose we take a two-dimensional matrix of LEDs approximately 1024 by 1024, or, since I have already noted the comparison, a TV

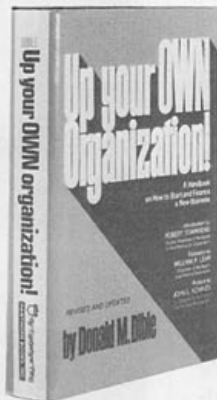
screen and mount it on our track. Again we move it back and forth, but this time our two-dimensional screen is sweeping out a volume of space, i.e. three dimensions. The computer holds information representing many slices of space, perhaps over a thousand such planes, and displays the appropriate one on the screen or LED matrix as the surface moves through its discrete positions along the track. Remember that it is moving back and forth at a very high rate. The result is a three-dimensional image in space.

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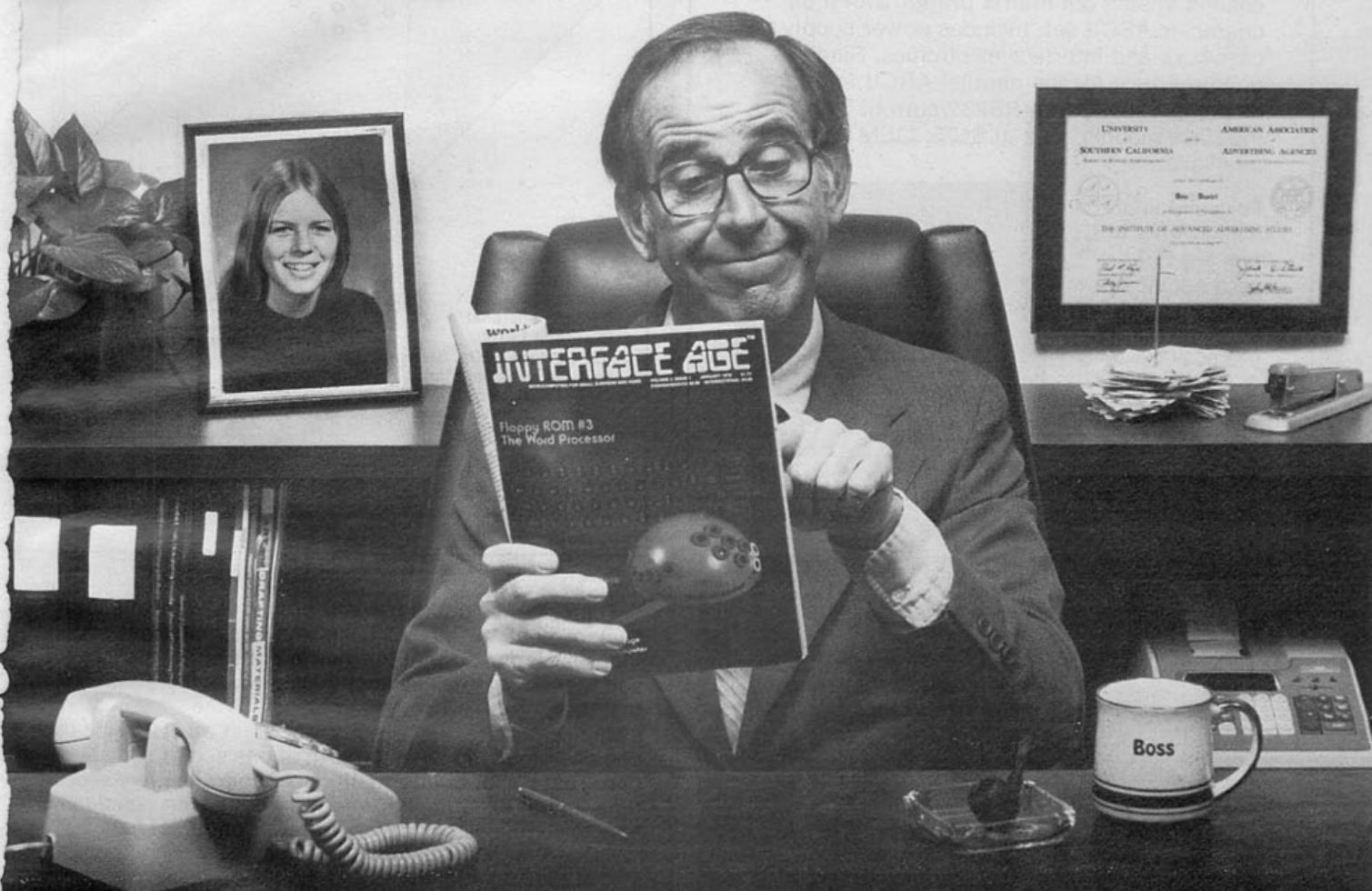
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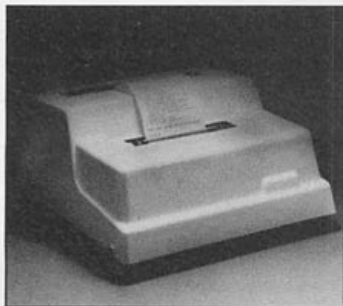
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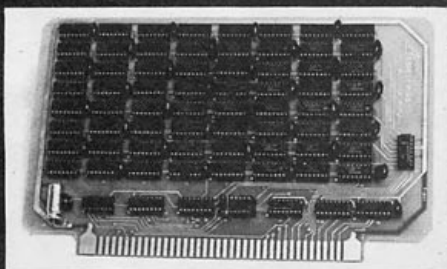
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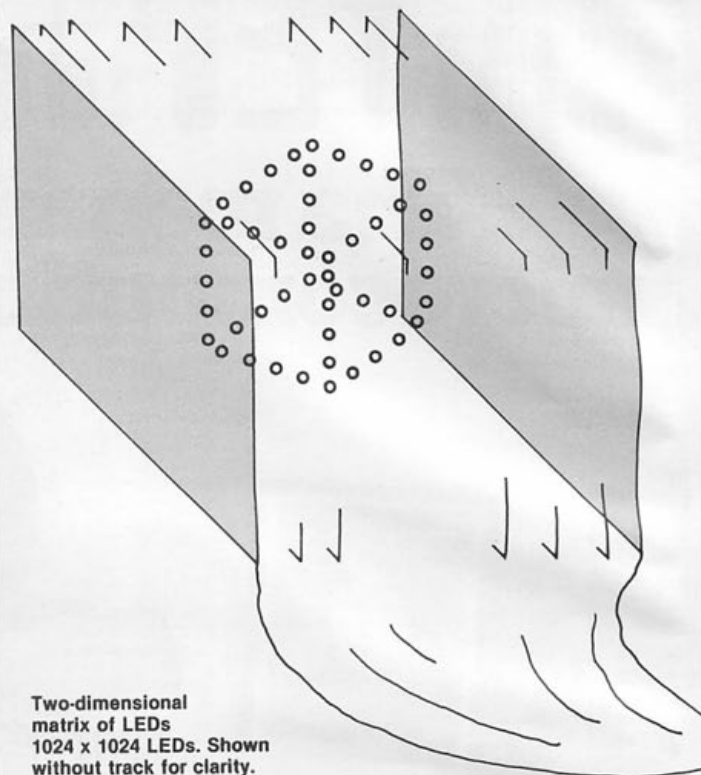


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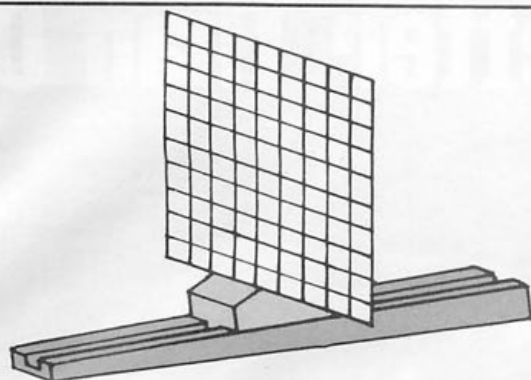
Two-dimensional matrix of LEDs  
1024 x 1024 LEDs. Shown without track for clarity.

There are, of course, some problems with this. The screen must be moved back and forth at least sixty times a second so that the viewer does not perceive image flicker. This has several implications. If we assume that there are 1024 discrete positions of the screen, then each slice of the displayed object must be displayed in one one-thousand-twenty-fourth of one sixtieth of a second. That's a lot of information to display in a very short time. Initial experiments might be done with considerably fewer slices of space and fewer points per slice.

Moving a TV screen twenty inches back and forth at sixty cycles per second would require a substantial amount of energy and would probably result in a lot of little pieces of TV flying about the room. Even an LED matrix would have too much mass to withstand the shaking. The solution is simple.

We position the screen with a lens system that collimates the image upward. This means that if we display an image on the screen and place a flat surface anywhere above the lens and perpendicular to the vertical, the image will be focused on that surface. Now, we could move the flat surface up and down at sixty cycles per second while appropriately displaying the slices on the TV screen, but we will still have a vibration problem.

Suppose, however, that we position a spiral-shaped plate above the lens system. The plate would be made of an opaque material so that an image focused on it from below would be visible from above as well. This plate is enclosed in a solid circular block of clear plastic. The block is then rotated about its vertical axis at 60 revolutions per second with the computer knowing its rotational position at any given moment.



A two-dimensional matrix of LEDs is mounted on the track and moved back and forth.

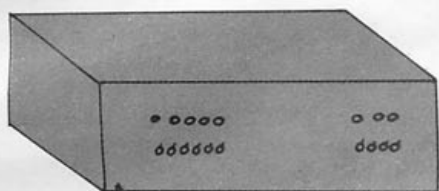
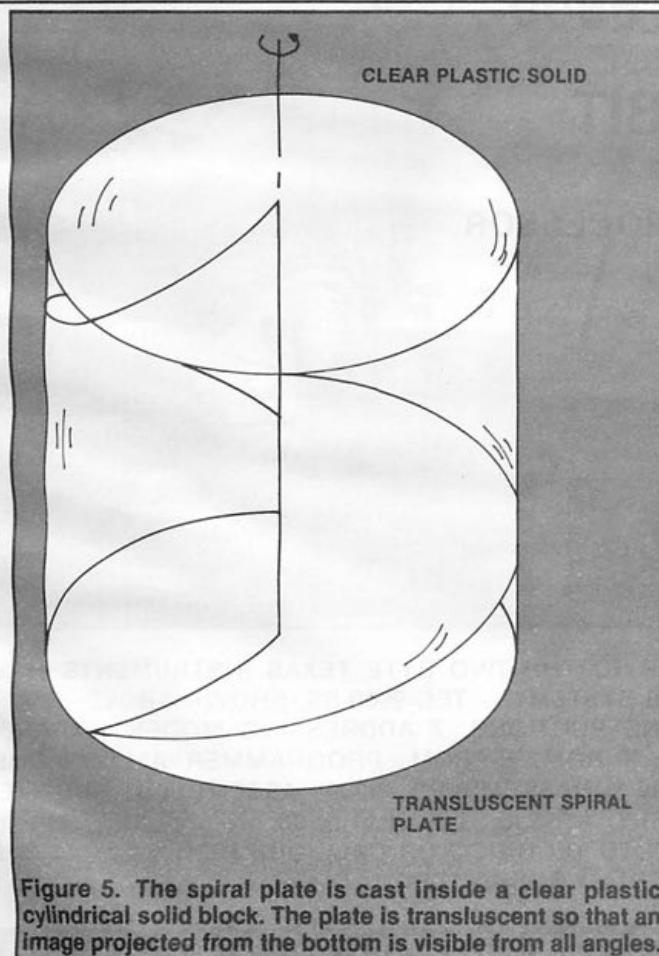


Figure 4. The LED matrix sweeps out a volume of space. The computer, by turning the individual LEDs on and off at appropriate positions as the matrix moves back and forth, can display any three-dimensional object and even make it "move" in space.



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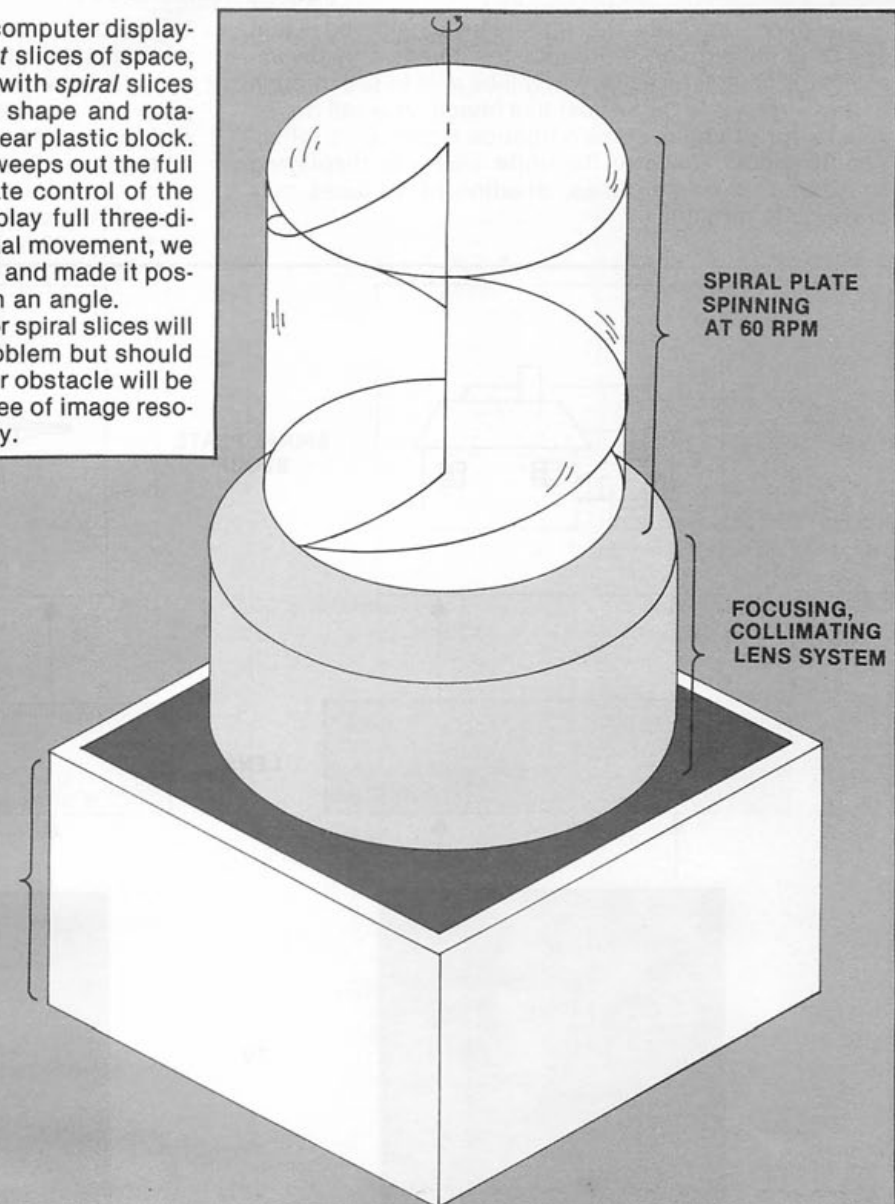
Calculating the appropriate images for spiral slices will prove to be an interesting software problem but should not be unreasonably difficult. The major obstacle will be the timing of the displays and the degree of image resolution possible with today's technology.

**Figure 6.**  
The image on the TV screen is collimated by a set of lenses to focus on the spinning spiral plate.

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Yet think what an architect could do, constructing three-dimensional models of his design and making dynamic changes to it by simple instructions to a computer. Or how about playing chess with the computer and having the chessboard displayed and movements all made in 3D. Maybe even a Star Trek game could be programmed, with the Enterprise and enemy ships actually flying about in space, firing little beams of light at each other. Sounds fascinating. □

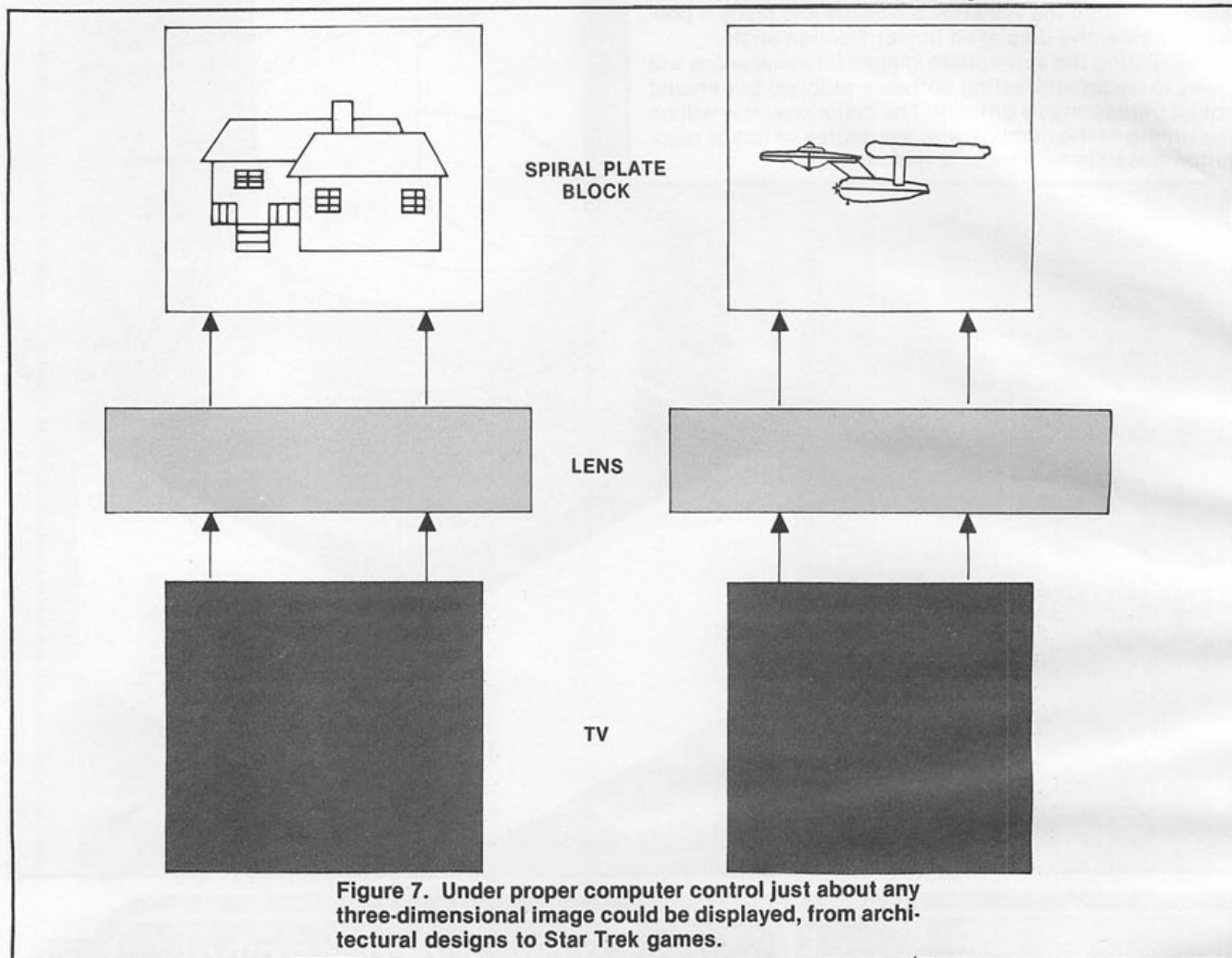
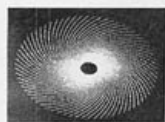


Figure 7. Under proper computer control just about any three-dimensional image could be displayed, from architectural designs to Star Trek games.

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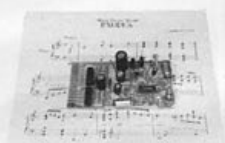
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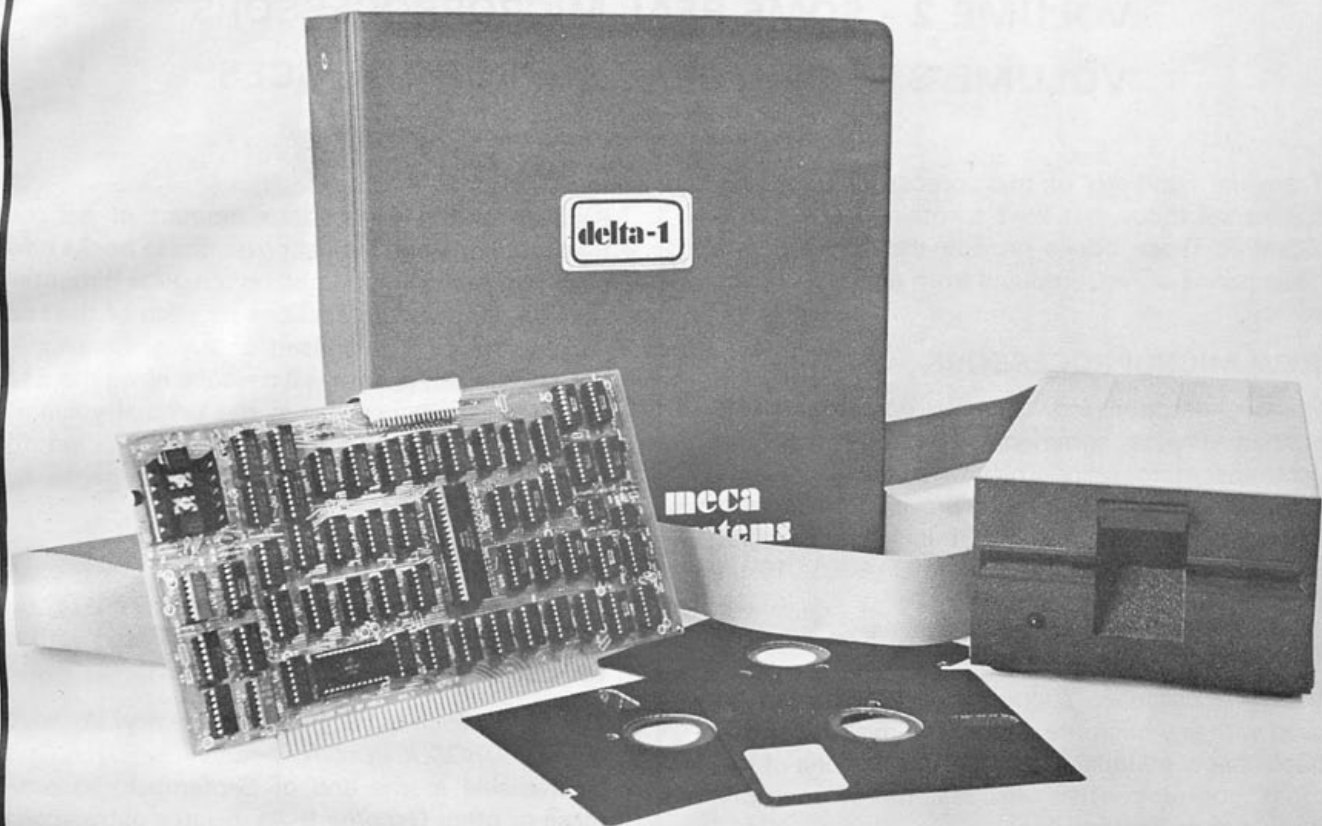
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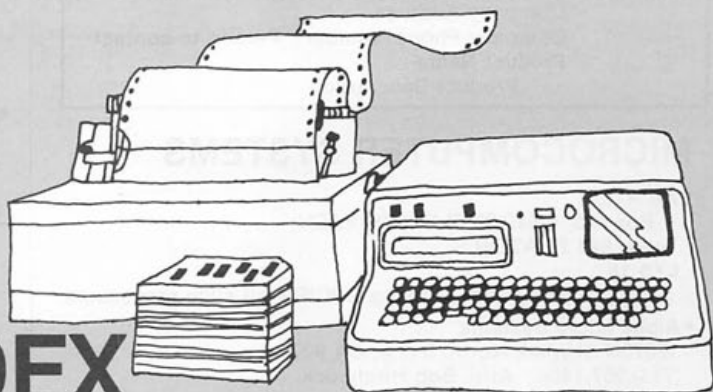
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# 1978 INDEX to Microcomputer and Minicomputer Hardware

What is the microcomputer industry made up of? Hardware, of course. The problem is that within a short three years, the industry has grown from just a few manufacturers to several hundred.

During these years, INTERFACE AGE has provided more pages to listing new products than any other magazine serving the industry. However, we felt that more was necessary, and have answered the problem in the form of an index to available hardware in this issue, to be followed by an index to available software in the November issue. December will bring the third index of available microcomputer books and literature. All three indexes are in response to suggestions from both readers and industry spokesmen, and consequently reflect what we feel to be the desired format.

## HARDWARE

The term hardware is meaningless as a word by itself since it can mean anything from a picture hanger to an IBM 370. For the purposes of this industry, hardware are the microcomputer systems, either as a mainframe, or a

complete system, or disks and tape units, power supplies, I/O cards and memory cards. Hardware is the physical boxes, cards and wires that make up a computer system. Each piece of hardware performs some function within the unit whole and as such is a separate entity by itself.

Hundreds of articles have been written on the functional purpose of each hardware piece, and even how to integrate them into a complete unit. Within the hardware scheme is the term "iron" which is usually defined as that box which contains all the hardware pieces to be a functional computer of some sort. Therefore, iron, although by definition a piece of hardware, becomes separate as a hardware item.

What this is all leading up to is that hardware and iron refer to different components and are sometimes hard to find or differentiate from, depending upon a person's specific needs. The purpose of this index is not to define each hardware piece as to functional purpose, but to provide a list of what is available to the computer user market and an index to OEMs or system houses that are preparing finished end products.

## Table of Contents

MICROCOMPUTER SYSTEMS .....	62
PERIPHERALS .....	65
DISKS/TAPES .....	68
TERMINALS .....	70

## REFERENCE EXAMPLE

• **Company Name or •COMPANY NAME**  
Company Address  
Company Phone Number Person to contact  
**Product Name**  
Product Description

## MICROCOMPUTER SYSTEMS

- **AB ATEW**  
Box 125, S-642 00 FLEN, SWEDEN  
Telex, 641 20 ATEW S  
**LYS 16**  
16-bit CPU system — using GPC/P 4-bit slice processors
- **Alpha Micro Systems**  
17875N Skypark North, Irvine, CA 92714  
(714) 957-1404 Attn: Bob Hitchcock  
**AM-100**  
16-bit microcomputer system
- **Andromeda Systems Inc.**  
14701 Arminta Street, Suite J, Panorama City, CA 91402  
(213) 781-6000 Attn: Les Lazar  
**Model 11/B**  
LSI-11 based dual floppy system  
**Model 11/H**  
LSI-11 based cartridge disk system  
**Model 11/M**  
LSI-11 based mini-floppy system
- **APF Electronics Inc.**  
444 Madison Avenue, New York, NY 10022  
(212) 758-7550 Attn: Neil Lipper  
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### Micro Nova 9045

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### LSI 4

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(916) 929-2020 Attn: Roger Lotz

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(714) 436-3512 Attn: Sales Manager

### C-BS

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### C-3D

Software development system, CRT, 80-132 column printer, floppy disk, PROM board, PROM programmer

### • Cromemco Inc.

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(415) 964-7400 Attn: Dr. Alice Ahlgren

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(415) 326-6141 Attn: Bruce Brough

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• **Interact Electronics Inc.**

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(313) 973-0120 Attn: Michael Tucker

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• **The Interpring Group Inc.**

50 Hunt Street, Watertown, MA 02172  
(617) 926-1510 Attn: Sharon Rogolsky

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714 N. Brookhurst, Anaheim, CA 92803  
(714) 774-1010 Attn: John Pagliaro

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**System 8813**

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• **Process Computer Systems, Inc.**

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(313) 429-4971 Attn: Tim Pellegrino

**3800B**

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(201) 681-8700 Attn: John Lacatel

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• **R2E of America**

3406 University Avenue S.E., Minneapolis, MN 55414  
(216) 562-9908 Attn: Ronald Larsen

**Micral Cm**

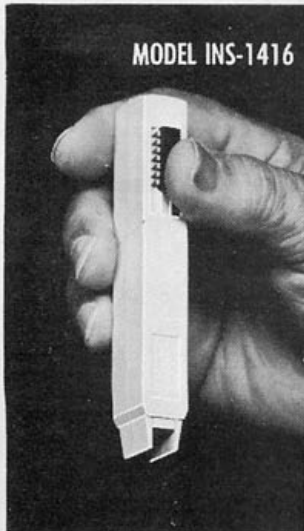
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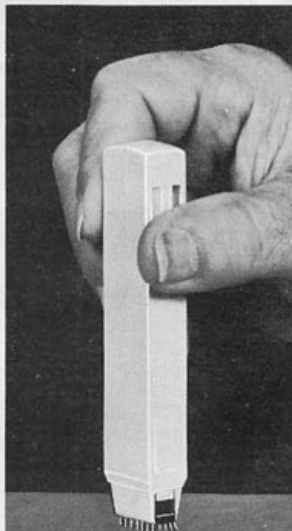
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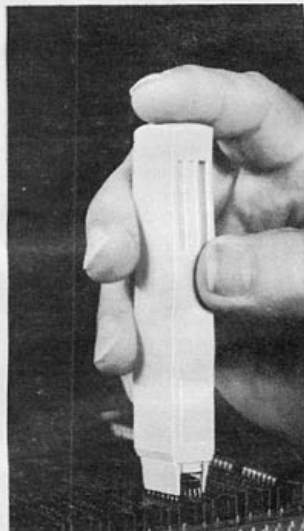
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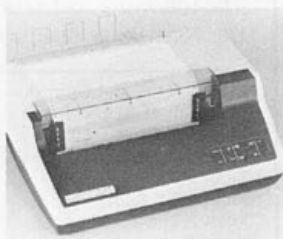
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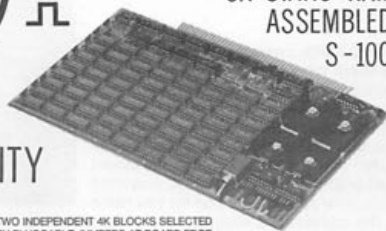
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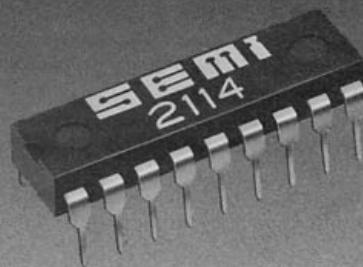
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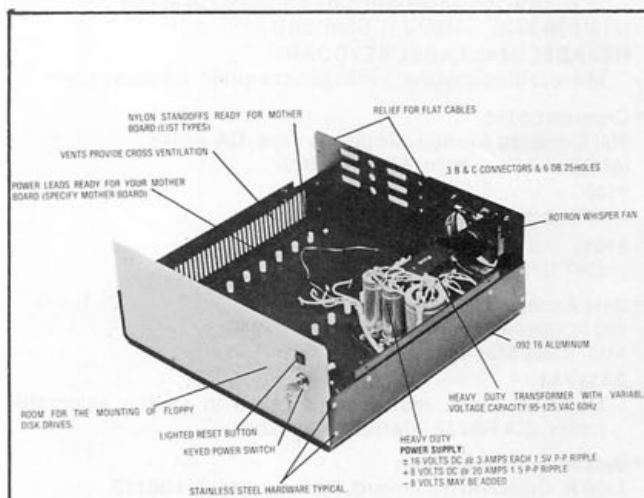


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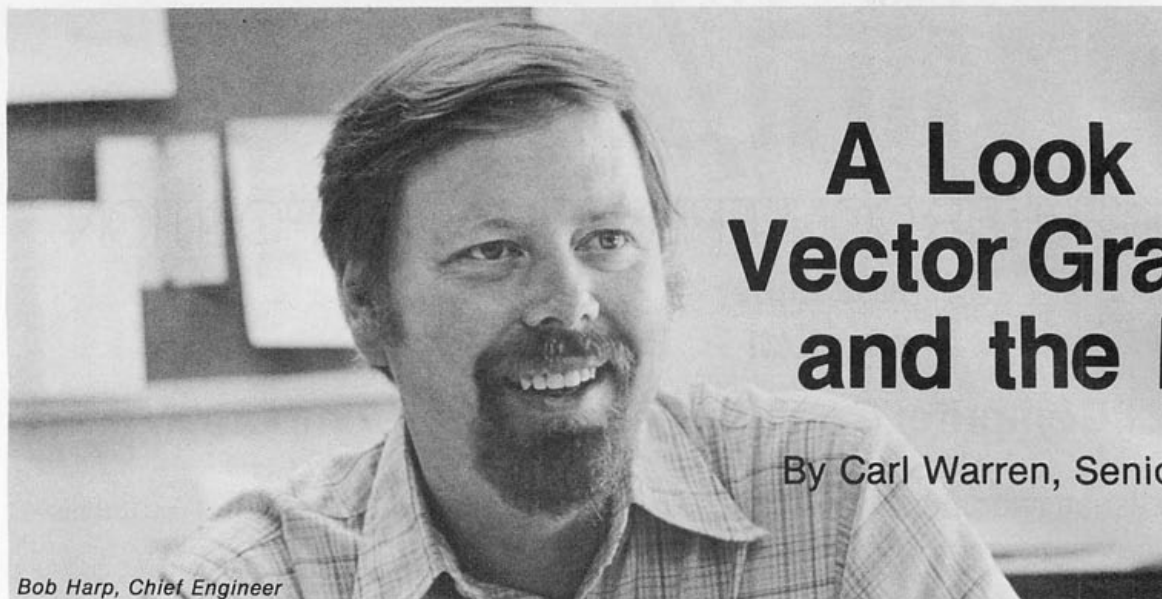
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Bob Harp, Chief Engineer

# A Look At Vector Graphic and the MZ

By Carl Warren, Senior Editor

As the microcomputer industry has matured and the market place changed from the hobbyist to the small business user, so has the system design concept of many manufacturers. One of these manufacturers, Vector Graphic Inc. of Westlake Village, California, has recognized the needs of the small business user and has developed a complete system based on the Z-80 CPU. This system is the logical outgrowth of the systems components that have been the mainstay of the Vector Graphic product line.

Beginning two years ago as a supplier of memory boards for S-100 bus type computer systems, Vector Graphic has developed I/O boards, disk systems and now a complete system that utilizes each functional board of the Vector line.

The Vector MZ did not just happen overnight, but was the brainchild of Bob Harp, Vice President and chairman of the board of Vector Graphic. Bob is one of the truly gifted engineers in the microcomputer business today. He received a bachelor's degree in Physics from MIT, his masters and Ph.D. in Electrical Engineering from Stanford. After serving on the faculty of Caltech in Electrical Engineering, he moved to Hughes research where he won the Hyland Patent award for his design work. When asked how long he had been involved in electronics he said: "Ever since I was 10 years old, so about 30 years."

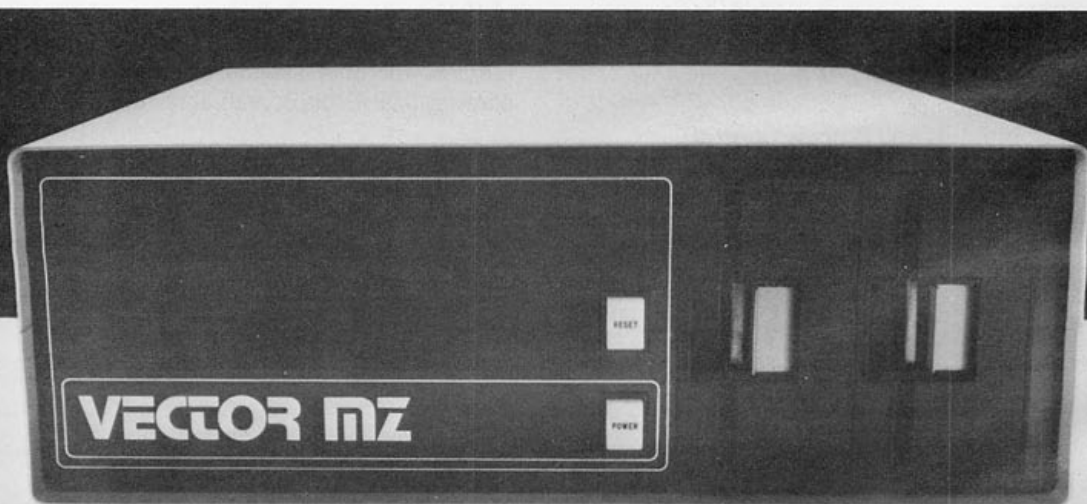
His 30 years of experience have proven to be significant when the quality of design is looked at in the Vector systems. A good example is the mother board used in the MZ. The top surface is a ground plane which reduces the physical amount of distance a signal must travel in the circuit. The result of this, of course, is greater reliability and less noise on the bus. The mother board is fully terminated and is serviced by a 22 amp power supply, which uses a transformer made specifically to Bob's specifications.

## A LOOK AT THE MZ

The MZ system sells for \$3,750 and comes complete with built-in 5.25-inch floppy disks, Z-80 CPU running at 4MHz, 32K static memory board, shielded and terminated mother board and a professional looking cabinet designed with the small businessman in mind.

The system also comes with Micropolis MDOS and BASIC, plus complete development software including an editor and assembler. CP/M is available at an extra charge. Vector also supplies a MZOS disk operating system which is compatible with software written for the North Star DOS.

Vector is also working on developmental software to assist the OEM and distributor network in developing application software for the end user.



The idea behind the MZ is to provide a complete package in the sense that for the price it is only necessary to purchase a terminal and a hardcopy device. Basically the complete minimum system includes: a CPU, PROM/ RAM board, workspace memory, a disk controller, and an I/O board. All of which are found in the MZ system.

Another important area of a complete system is the ease of use. The MZ provides a degree of turnkey operation by providing an immediate reset into the monitor on start up with a simple instruction to boot into the disk operating system. However, the degree of turnkey operation depends upon the applications design and desired interactivity.

## APPLICATIONS

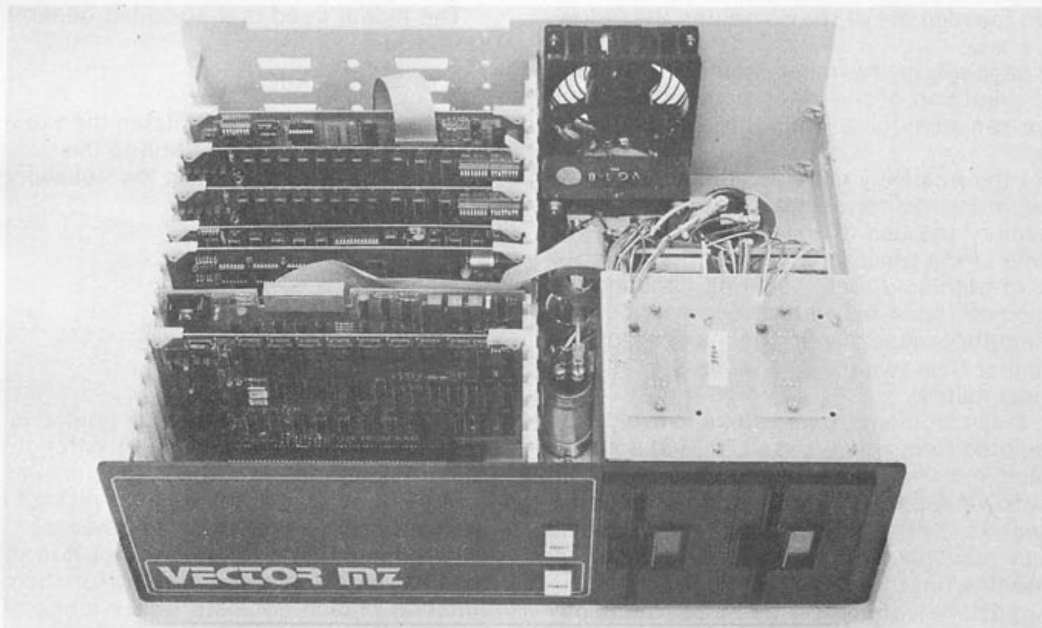
The MZ package comes with systems software that can be used by the dealer or end user to develop applications software that meet specific needs. Although Vector employs in-house programmers, the concern is with the systems software and not applications. Vector uses the third party vendor concept for applications software which means that the dealer will be supplying business software either off the shelf or designed specifically for a customer. The MZ lends itself readily to applications

for those users who need a different level of capability in their applications there is the Vector Graphic Mindless Terminal.

This terminal is built around the Ball Brothers video system and uses a capacitance keyboard. The terminal receives its power and intelligence from a video board that is placed directly on the bus. This makes it possible for the CPU to address the screen as memory, and as a result provides protected field capability. Using this type of system, the applications designer can use fill-in-format type application design and better human engineer the software.

Basically all the products that Vector Graphic makes are used in the complete MZ package, but they do have some other unique ideas that will interest another aspect of the microcomputer market.

This other aspect, and one not being addressed by most manufacturers, is the Amateur Radio market. They have developed a prototype digitizer that sits on the MZ bus or any S-100 bus for interpreting slow scan (amateur) television, which makes it possible to save it either on tape or disk media. Although Vector is not directly targeting to the HAM market the idea is to probe all



design since it has flexible operating systems and compatibility to S-100 add ons.

## THE MARKET

Vector is primarily addressing the small business market while at the same time providing high quality supplemental boards to the S-100 bus user market.

Vector works through OEMs and a dealer network whom they rely on to provide the level of service to the end user. As Bob Harp put it: "we really can't afford to provide a hand holding operation to the businessman, but we do make every effort to make sure that our dealers have sufficient information and understanding of the MZ system to provide the greatest benefit to the end user."

The marketing and general administrative functions of Vector Graphic is handled by Lore Harp and Carole Ely. Between them they concentrate on ensuring that production and shipping schedules are met and that dealers are kept apprised of new developments.

## OTHER DEVELOPMENTS

Along with the MZ system, Vector Graphic offers the Hazeltine terminal to round out the system. However,

facets of micro capabilities and develop useful devices and techniques that further enhance the micro as a business system and ultimately the industry.

## WHERE THEY ARE GOING

Vector Graphic is now into their third year of operation and have not found a limit to their possibilities. Bob Harp feels that with 1.75 million small businesses in the country today their growth is assured. He also feels that companies like IBM and DEC are headed toward obsolescence due to technology advances. By this he means that as newer and faster chips are developed, with greater system capabilities, companies like his can quickly provide the finished product. Systems like the MZ, he feels, will not really become obsolete since all that will be necessary to change, in most cases, will be the CPU board. However, to a company like IBM a change to a different technology means a massive change in the total system.

Bob's outlooks are not unlike many others in the microcomputer industry and goes to prove that micros are here to stay. Also that systems such as the MZ will have a major piece of the total market share. □

# A SPECIAL FUNCTION APPROXIMATION METHOD AND ITS APPLICATION

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It very often happens in the engineering practice that one must calculate with functions available in tabulated form. In calculations by computer connected with storing the table in the memory of the computer, the following problems arise:

- If storing happens in the inner memory, the table takes up a great part of the inner memory, and thus little place remains for storing the program and other data.
- Because of the relatively considerable access time of the background memory, when storing in the background memory the use of the table increases the running time of the program significantly.

In the case of both solutions, however, handling the table is an uncomfortable task which can only be realized with difficulty, especially if the number of the variables is higher than two (i.e. the table is more than two dimensional matrix).

Because of these problems, users strive to avoid storing in the tabulated form where possible. That solution could be applied in several cases where the table would be substituted by an approximate function of satisfactory accuracy at which the approximate function could be produced by relatively few program steps and relatively little machine time.

Also, an approximate function must be frequently composed from the description of a mass of facts from some measurement result.

Essentially, both works can be attributed to determination of approximate functions. For producing these functions, certain programs which attempt the approximation by a definite function type are very much in use. If the approximation is not of sufficient accuracy, they attempt by another program and another function type again. The set of function types is only some functions, and trying them is not automatic either. In many cases we do not succeed in achieving a satisfactory accuracy.

Solving this task is especially difficult when the capacity of the computer available is low, or its operating velocity is slight. In this case storing different programs which belong to different functions cannot be solved simultaneously, and the fulfillment of the repeated trials slackens the process to such an extent that it becomes practically unrealizable.

We do not review the programs of certain firms which are related to this article. We refer only to the literature.<sup>1-3</sup> We want to remark only that functions which are used to produce an approximate function are the following:

- linear, parabolic, exponential, hyperbolic, ellipse type.

Harold Balaban worked out a special solution.<sup>4</sup> The solution contains certain elements of our program which is why we deal with it in detail.

The model used is a so-called general linear regression model,

$$g/Y/ = b + mf/X/,$$

and the program also calculates the value of the regression coefficient  $r$ , in addition to the determination of  $b$  and  $m$ . The program tries the following cases automatically:

$$\begin{aligned} g/Y/ &= f/X/ = \text{linear} \\ f/X/ &= \text{SQR}/X/, \\ f/X/ &= \ln/X/, \\ f/X/ &= 1/X, \\ g/Y/ &= \ln/Y/; f/X/ = \ln/X/, \\ g/Y/ &= \ln/Y/, \end{aligned}$$

and the maximum number of points is 10. The SQR designation means the squaring. After giving in the data the program prints out the  $b$ ,  $m$ , and  $r$  values belonging to the 6 functions automatically without setting up any graduation. This method is an advantage in comparison with the traditional solutions since it is not necessary to feed the data again, function by function. However, the function choice consists of six kinds of functions altogether; the number of variables is two, and the number of the data is considerably limited. Neither the number of the variables nor the function is the user's task.

The application of our program packet has the following advantages:

- Trying over the functions is automatic. Hence, it is not necessary to feed in the data again.
- The number of functions tried over automatically is maximum 1296.
- Selecting the "best" function occurs automatically.
- The number of the data is not so severely limited as in the case of the program reported previously.

Its limit is restricted by the extent of the inner (if it is available) or background memory of the machine.

One special advantage of this program packet is the relative ease in which it is generalized, and this means the number and kind of functions can be changed (increased), the number of variables can be increased, and the data number permitted can be increased by the application of background memory. Naturally it is necessary to take the increase of the operating time into consideration, too.

In the case of two variables, the program uses the following relation for producing the approximate function:

$$G/y_i = b + mf/x_i$$

where  $f_i$ ,  $g_i$  mean some kind of function selected from the function set in the program. The program determines the values of  $b$  and  $m$  to a certain  $f$ ,  $g$  pair by means of the known square-error minimum method. It is a substantial deviation, however, that the formula to be minimized is as follows:

$$\sum_{i=1}^n \left[ 1 - \frac{b + mf/x_i}{g/y_i} \right]^2 = \min! \quad /1/$$

At the same time it determines a quantity which serves for characterizing the errors. The determination of the "best" function approximation occurs in such a manner that the program selects an  $f$ ,  $g$  function pair automatically from the function form set available. It also performs the determination of the constants by each function pairs and the value of a quantity serving for the characterization of the errors quoted by  $S$  in the following. It selects the function form which can be characterized by the least error by comparing the  $S$  values.

The necessary operating time:

$$T = bntm^b \quad /2/$$

where  $b$  is the number of the variables (independent and dependent variables);  $n$  is the number of data points;  $m$  is the kind of number of the function forms in the function set;  $t$  is a constant depending on the machine type and the program.

The following relation defines the quantity serving for the characterization of the values of the errors:

$$s = \frac{1}{n} \sqrt{\sum_{i=1}^n \left[ 1 - \frac{b + mf/x_i}{g/y_i} \right]^2} \quad /3/$$

The  $s$ -error function is characteristic of the mean error. The greater its value, the bigger is the mean error, so we look for the minimum of this function.

These programs are four variants:

- two variables /BASIC-4K/,
- two variables /BASIC-8K/,
- four variables,
- two variables and one parameter.

## FUNCTION APPROXIMATION WITH TWO VARIABLES /BASIC-4K/

The program:

- Line 2-55: Erase of the screen; print of the heading and legend.  
Line 60: If the memory is 4K byte upon the BASIC interpreter, then

$$N_{\max} = 65$$

If your memory is bigger than 4K byte, then you may want to modify this line.

- Line 70: Input number of data points  
Line 80: Print heading of the data columns  
Line 90-120: Input, store and print of the data  
Line 130-145: Initializing of the value of the constants. The function is "good" in this variant if

$$S < \frac{3 \times 10^{-2}}{N}$$

- Line 146-151: Compute and store the value of

$$X_{\max}, X_{\min}, Y_{\max}, Y_{\min}$$

- Line 152-155: Transform of the value of  $x, y$ . The new values are:  
 $0 < x, y < 1$

The equations are:

$$x_{\text{new}} = \frac{x - x_{\min} + 1}{x_{\max} - x_{\min} + 1}$$

$$y_{\text{new}} = \frac{y - y_{\min} + 1}{y_{\max} - y_{\min} + 1}$$

- Line 160-180: Compute of the serial number of the function pair.

- Line 190-270: Compute of the value of  $F/x_i$ ,  $G/y_i$  with the subroutines from the line 500. Store of the value of  $F_i$ ,  $G_i$ .

- Line 280-320: Compute of the value of the invalid variable.

- Line 340-350: Compute of the value of  $A, B$ -constants.

- Line 360: Compute of the value  $S^2 \times N^2$ . This line is indexed "S".

- Line 370: Is the new function form "better" than old? If yes, then go to 430.

- Line 380: If no, then: Is not more function form? Yes or no; If yes, then go to 160

$$M_{\max} = 100$$

Line 390-415: Compute and print of the results and the name of the "good" function.

Line 430-470: Store of the new constants.

Line 480: Is the function form "good"? Yes or no? If yes, then go to 390.

Line 490: If no, then go to 380.

Line 500-860: Compute of the value of the functions.

Line 515-530: COS/ /-subroutine

Line 541-549: SIN/ /-subroutine.

If

$$P > = \pi/4,$$

then

$$\text{COS}/P/ = \text{SIN}/\frac{\pi}{2} - P/$$

and

$$\text{SIN}/P/ = \text{COS}/\frac{\pi}{2} - P/$$

Line 550-560: Linear function.

Line 570-590: Parabolic function.

Line 600-616: LOG/ /-subroutine.

Line 630-650: EXP/ /-subroutine.

Line 660-680: Compute of the square-root with the following equation:

$$\text{SQR}/X/ = \text{EXP}/\frac{\text{LOG}/X/}{2}/$$

Line 690-710: Reciprocal function.

Line 750-820: ASIN/ /-subroutine.

Line 830-860: Compute of the ACOS/ /-function with the following equation:

$$\text{ACOS}/X/ = \frac{\pi}{2} - \text{ASIN}/X/$$

The mean error of these subroutines:

$$\sim 0.02\%$$

The computing time is:

$$T \sim 10 \times N \quad / \text{minute}$$

The machine was a SWTPC-6800.

### FUNCTION APPROXIMATION WITH TWO VARIABLES /BASIC-8K/

The program is 40% shorter than the 4K-variant. The computing time is:

$$T \sim 3 \times N \quad / \text{minute}/$$

If the memory is 4 Kbyte upon the BASIC-interpreter, then:

$$N_{\max} = 80.$$

The program:

Line 2-230: Is not different from the 4K-variant.

Line 240: The name of the function is a string variable.

Line 250-350: Is not different from the 4K-variant.

Line 360: Compute of the value "S".

Line 370-390: Is not different from the 4K-variant.

Line 400-420: Print of the name of the functions is only one line. (25 lines are in the 4K-variant).

Line 430-450: Is not different from the 4K-variant.

Line 460-470: The name of the functions are strings.

Line 480-500: Is not different from the 4K-variant.

Line 520-710: In this version is not subroutine for COS/ /, SIN/ /, LOG/ /, EXP/ /, SQR/ /. This part has 23 lines. (53 lines are in the 4K-version.)

Line 750-860: Is not different from the 4K-variant.

### FUNCTION APPROXIMATION WITH FOUR VARIABLES

A detailed review of the program will not be described herein. Figure 1 illustrates a simplified flow chart. In the figure are:

1. data acquisition, store;
2. initializing of the inner constants,

$S_0/S_0 = 1/S_{\min}$  and  $M/M_0 = 1$ ,  
M-serial number of the constants of the function form;

3. computation of the constants of the linearized system of equations;
4. solution of the linear system of equations;
5. computation of the error function  $|S|$ ;
6. initialization of the inner constants;
7. printout of the best function form and printout of the values of the constants of the function; and
8. storage of the best function form,  $S_0$ , and storage of the values of the constants of the function.

This version is good on a rapid machine only because the machine time is high. For example:

$$T \sim .5 \times N \quad / \text{hour}/$$

was on a Wang 2200 B.

### FUNCTION APPROXIMATION WITH TWO VARIABLES AND ONE PARAMETER

The problem is the following: Let us look at some of the serial data points and

$$y = f/x, \alpha/$$

where x,y-variables,  $\alpha$ -parameter of serial, and we should like to get

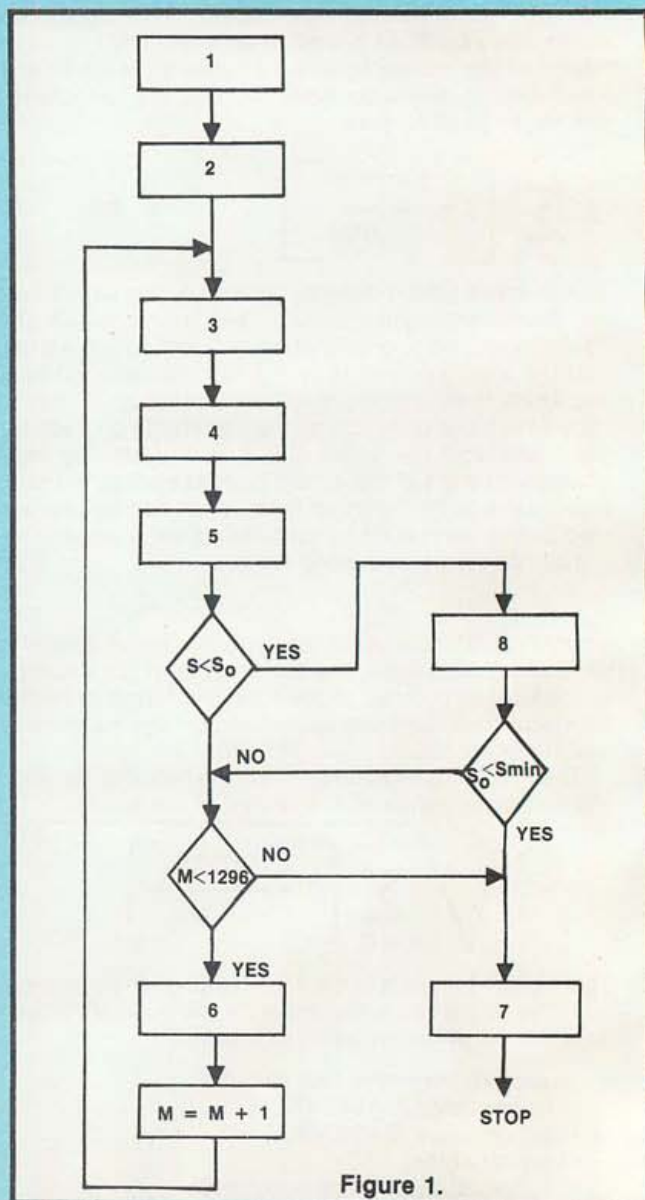


Figure 1.

$$G/y = A/a + B/a \times F/x$$

approximation function with "good" S-value for all serial.

An example: Function of the electrical resistivity from the temperature:

$$R = f/T, \text{ kind of substance}$$

We search

$$G/R = A + B \times F/T$$

functions, where A,B-functions of the kind of substance. A result is the well known

$$R = R_0 \times /1 + \alpha \times \Delta T/$$

where

$$A = R_0 \times /1 + T_0/$$

$$B = \alpha \times R_0$$

$$G/ = F/ = \text{linear.}$$

My recent method connected with the generalized function approximation program drastically reduces the theoretical work required for setting up the approximating functions usable in practice. The method described by our newest program is as follows:

- /a/ Measurement data which is to be described by the relation sought is input.
- /b/ The program then chooses the "good" function forms. A function is "good" which produces a greater accuracy than that given beforehand. The computer stores these function forms together with the error values and the constants which belong to the function forms and the measurement data, respectively.
- /c/ Data belonging to the next type of substance is input.
- /d/ The program then investigates the function forms found to be "good" for the first substance type. It selects those from the ones which give a "good" value for this material. The stored data are identical with the data described in /b/. We then repeat those written in the /c/ and /d/ for all substance types.
- /e/ Finally, the value of the constants and the errors belonging to the single measurement data for all the materials are calculated.

Thus, setting up an approximating function simplifies into feeding in the measurement data and reading the result. We do not review the application of the programs; we refer only to the literature.<sup>5-9</sup> □

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- <sup>5</sup>SWAP Program Library 1974. S. 199-7.8.
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- <sup>9</sup>Varadi-Simonyi-Serege: IMSZI 206/1974. sz. szakvelemen 1975. maj. (In Hungarian)
- <sup>10</sup>E. Simonyi: A Special Function Approximation Method and Its Application. March 1977, Vol. 11, No. 1, 12-15.

## PROGRAM LISTING


```

0002 REM
0005 PRINT TAB CHR$(16),CHR$(22)
0010 PRINT TAB(13), FUNCTION APPROXIMATION WITH TWO VARIABLES
0020 PRINT
0030 PRINT FUNCTION FORM: G(Y)=A+B*F(X)
0031 PRINT WHERE: G( ),F( )-FUNCTIONS
0040 PRINT X,Y-VARIABLES
0041 PRINT A,B-CONSTANTS
0045 PRINT RELATIVE STANDARD ERROR: S=SQR(SUM(1-(B*X+A)/Y)^2)/N
0050 PRINT
0055 PRINT N=NUMBER OF DATA POINTS
0060 DIM X(80),Y(80)
0070 INPUT N
0080 PRINT X , Y
0090 FOR I=1TON
0100 INPUT X(I),Y(I)
0110 PRINT X(I),Y(I)
0120 NEXT I
0130 S0=1
0140 M=0
0141 S1=1E-3
0142 X1=1
0143 X2=0
0144 Y1=1
0145 Y2=0
0146 FOR I=1TON
0147 IF X(I)<X1THENX1=X(I)
0148 IF X(I)>X2THENX2=X(I)
0149 IF Y(I)<Y1THENY1=Y(I)
0150 IF Y(I)>Y2THENY2=Y(I)
0151 NEXT I
0152 FOR I=1TON
0153 X(I)=(X(I)-X1+1)/(X2-X1+1)
0154 Y(I)=(Y(I)-Y1+1)/(Y2-Y1+1)
0155 NEXT I
0160 M=M+1
0170 J1=M-10*INT((M-1)/10)
0180 J2=1+INT((M-1)/10)
0190 FOR I=1TON
0200 P=X(I)
0210 J=J1
0220 GOSUB 500
0230 U=P
0240 D$=H$
0250 P=Y(I)
0260 J=J2
0270 GOSUB 500
0272 IF ABS(P)<1E-20 THEN P=1E-20
0274 IF ABS(U)>1E10 THEN U=1E10
0280 C1=C1+U/(P*P)
0290 C2=C2+(U*U)/(P*P)
0300 C3=C3+U/P
0310 C4=C4+1/P
0320 C5=C5+1/(P*P)
0330 NEXT I
0335 IF C5*C2=C1*C1 THEN C5=C5*1.0000001
0340 B1=(C5*C3-C1*C4)/(C5*C2-C1*C1)
0350 A1=(C4-B1*C1)/C5
0360 S=SQR(ABS(N-2*B1*C3+B1*B1*C2-2*A1*C4+2*A1*B1*C1+A1*A1*C5))/N
0370 IF S<S0THEN430
0380 IF M<=100THEN160
0390 PRINT N= ;N, A= ;A, B= ;B, S= ;S0
0400 PRINT F( )= ;F$, G( )= ;G$
0420 STOP
0430 S0=S
0440 A=A1
0450 B=B1
0460 F$=D$
0470 G$=H$
0480 IF S0<S1THEN390
0490 GOTO 380
0500 ON J GOSUB520,542,550,570,600,630,660,690,750,830
0510 RETURN
0520 H$=COS( )
0530 P=COS(P)
0540 RETURN
0542 H$=SIN( )
0544 P=SIN(P)
0546 RETURN
0550 H$=( )
0560 RETURN
0570 H$=( )^2
0580 P=P*P
0590 RETURN
0600 H$=LOG( )
0610 P=LOG(P)
0620 RETURN
0630 H$=EXP( )
0640 P=EXP(P)
0650 RETURN
0660 H$=SQR( )
0670 P=SQR(P)
0680 RETURN
0690 H$=1/( )
0700 P=1/P
0710 RETURN
0750 H$=ACOS( )
0760 K=9
0770 L=P
0775 O=0
0780 FOR R=2TOK
0790 L=((2*R-3)*(2*R-3)*P*P*L)/((2*R-2)*(2*R-1))
0800 O=O+L
0810 NEXT R
0815 P=O+P
0820 RETURN
0830 H$=ASIN( )
0840 GOSUB760
0850 P=355/226-P
0860 RETURN

```

# The Auto Industry Moves to Microprocessors

By Robert S. Koster, M.B.A.  
and Leslie D. Ball, Ph.D.



During the last several years the automobile has changed dramatically. The changes have occurred as a result of increases in government regulation which impact on the performance of the vehicle.

To a lesser extent, changes in American driving habits have caused some of the changes to occur.

While the automobile has changed, so have computers. In the early 1950's, several automobiles might fit inside of a computer, while today several computers would be easily placed inside of an automobile. Computer technology has moved to miniaturization and has increased the areas in which they might be employed.

It is not surprising, then, that the automotive industry has looked to computers to assist them in meeting government regulations. In this article the authors describe microprocessors which are the technology that allows the automotive industry to incorporate computers in current and future designs. In addition, the authors review what those current uses of microprocessors are and how we might expect the automotive industry to employ them in the future.

## WHAT ARE MICROPROCESSORS?

A microprocessor is the central processing unit (CPU) of a computer, reduced in size to fit on a single silicon chip. Its functions, like those of a larger CPU, are to receive data, store it for processing, perform arithmetic and logic operations, and to output results. With the addition of some input/output chips and more memory, a microprocessor is transformed into a microcomputer. The distinction between a processor and a computer is often blurred, and frequently, the terms are used synonymously.

The microprocessor owes its existence to the technology of large scale integration. This technology allows the

incorporation of thousands of electronic components in the space formerly occupied by only one or two components. Like many of its predecessors, such as transistors, the microprocessor is being hailed as one in the chain of electronic miracles that has and will continue to have a profound influence on our lives. Because they are so small and inexpensive, the microprocessor is being used in many previously unheard of applications from intelligent instruments to electronic games.

For many applications, the value of a microprocessor is the built-in control function that it can add. It can provide a very sophisticated, yet inexpensive, feedback loop which allows it to be incorporated into many non-computing devices.

Also, since the microprocessor serves as the guts of a microcomputer, it can bring computing down to a highly decentralized or distributive system. In these systems, each user can have his own computer and data base which communicate with each other rather than just employing terminals tied to a large computer. The use of microcomputers can certainly be compared to the history of electronic calculators since as the cost is reduced, their use and importance will increase significantly.

## WHY MICROPROCESSORS AND AUTOMOBILES?

In automobiles, microprocessor use can be most easily traced to the government mandate that motor vehicles meet very strict emissions and fuel economy standards. While the regulation of either pollution or economy may not have individually pushed the automotive engineers



to microprocessors, the combination of these two contradictory goals has required a degree of control that is not possible with previously employed mechanical means.

The microprocessor provides the feedback mechanism to insure that the engine is running at the efficiency level necessary to comply with government standards. Because the microprocessor is constantly finetuning the engine, it can maintain optimal performance, even as parts are wearing and the environmental conditions are changing. This heuristic feature is significant because government regulations are leaning to maintaining standards rather than just meeting them at the time of sale.

While it might be unfair to give the federal government all the credit for the use of microprocessors in automobiles, it is quite unlikely that computer technology would be finding its way into cars so quickly without government action. This is especially true since minimizing engine emissions is not cost reducing or inherently marketable. Without strict government regulation, microprocessors would slowly find their way into luxury vehicles for driver convenience and comfort. It is quite probable that as costs were reduced and more applications discovered, that microprocessors would find their way into cars in many different functions. What the government has done is to accelerate development and concentrate that development in areas believed by Congress to be important.

#### IGNITION SYSTEMS

Although computer technology will find its way into many automotive systems in the future, the most immediate application is the ignition system. The Oldsmobile Toronado is the only production automobile currently equipped with a microprocessor. By 1981, the year of stringent emissions controls, the use of microprocessors will be widespread.

The general function that a microprocessor will perform is to control the timing of the spark. The Delco-Remy Microprocessed Sensing and Automatic Regulation System offered in the Oldsmobile does what its name implies. It will control spark timing for all load and speed conditions consistent with driveability while

complying with all emission

control requirements. This system has four sensors that input crankshaft position, manifold vacuum, coolant temperature, and reference timing. As these inputs do not tax the capacity of the microprocessor, other control functions could be added to the system later.<sup>1</sup>

Ford will introduce a microprocessor system in its Versailles V8 5-litre engine to control spark timing and exhaust gas recirculation. Buick has introduced a closed loop knock-limiting system on their 1978 V6 Turbocharged 3.8-litre engine. The Buick system is an analog system which employs one sensor that actually hears engine detonation and sends a signal to retard the spark. This system is quite different from the microprocessor systems because it functions only as a knock limiter and has no other control features.<sup>2</sup>

Chrysler is presently developing a microprocessor to replace its present analog lean burn spark timing system. The system, developed for Chrysler by Texas Instruments, Inc. and RCA Corporation, accepts data from several different inputs to control emissions. These inputs are: ambient air temperature, throttle position, throttle rate of change of position, crankshaft position, intake manifold vacuum, engine coolant temperature, and inlet air temperature.<sup>3</sup> The microprocessor digests the information and adjusts the timing accordingly. Mechanical means do not provide for this level of control, but until quite recently, there had been no motivation to precisely control spark timing.

The microprocessor does not actually perform engine timing; it merely maintains it at optimum levels. This is a large distinction. When the microprocessor acts as a monitor of engine performance, its failure would not prevent the engine from operating. It would only reduce its performance to that achieved from mechanical control. If the microprocessor performed the engine timing, a failure would prevent the engine from working.

This monitoring function also greatly reduces the amount of data that the microprocessor must process. As a monitor, it is only comparing actual performance with the ideal and making corrections. This function requires only a few commands every second, rather than the hundreds required if it actually performed the function.

#### SENSOR TECHNOLOGY

Electronic engine control systems depend on sensors to measure environmental factors and report this infor-

mation back to the control unit. Since the sensors measure, they are analog in nature. This analog signal must be converted into digital form in order to be processed by the microprocessor. A special interface circuit translates the sensor's analog signal into the microprocessor's digital language. Design of this interface is critical because anticipated changes in the sensor must be incorporated into the microprocessor chip.

While technology in digital circuits is constantly reducing microprocessor costs, similar advances in sensor design must be accomplished to reduce total system costs to levels acceptable to the automotive industry. As all microprocessor based engine control requires sensors to gather information, the limiting factor is the cost and reliability of the necessary sensors and not microprocessor considerations.<sup>4</sup>

Automotive sensors measure five different functions: temperature, pressure, position, fluid flow, and environmental factors. Temperature sensors are the most widespread and are used to measure air, coolant, exhaust, oil, and catalyst temperature. Pressure sensors report on manifold, barometric, or brake line pressure. Position sensors are used in the distributor and measure crankshaft and accelerator throttle position. Fluid flow sensors are employed to monitor fuel consumption or oil circulation. Environmental sensors measure humidity and gas composition and are used in both spark timing and emission control.

Specific problems with each type of sensor vary, but many suffer in environments of extreme temperature and extreme vibration. In addition, most are costly. Many sensors require external devices to function properly. Until the reliability and cost factors can be solved, sensors will be the limiting factor in microprocessed engine control.

#### ADDITIONAL PROBLEMS

The automotive environment provides unique problems for electronic devices. The engine compartment is particularly harsh since temperature ranges from -40C to 120C, humidity from 0.1g/kg to 200g/kg, corrosive and contaminating liquids are present, and vibration, shock, and high electromagnetic impulses all must be considered.

In the Oldsmobile, engineers decided that the best solution was to locate the microprocessor in the passenger compartment. This solves one problem but requires expensive wiring. The Chrysler microprocessor is located in the engine compartment, next to the air cleaner.

A major decision facing the engineers is the trade-off between a general purpose or a specific application microprocessor. The anticipated production volume by the auto makers make the development costs of a specific or dedicated microprocessor cost effective. The Delco/Remy and the TI/RCA units that are currently in development or use do not employ dedicated microprocessors. The primary reason is that these are the first systems to be used in this application, and there has not been the time or the money to develop a custom tailored unit so quickly. Also, these systems are at the forefront of both computer and automotive technology, and the engineers have not clearly defined their needs. In addition, it is not clear that the semiconductor industry could produce a chip to the automotive engineers' specifications.

The problem is further complicated because the technologies and requirements are constantly changing. The automotive manufacturers want workable systems now but expect to continually make changes to reduce cost and increase efficiency. By the mid 1980's nearly every American car will contain one or more microprocessors.<sup>5</sup> Therefore, the potential volume is ten million units per year or more. The microprocessor industry is willing to cater to the needs of the automobile industry, but until

more systems are put into use, specific industry needs will remain uncertain.

#### SOFTWARE AND TESTING CONSIDERATIONS

Development costs fall into three categories: hardware, software, and testing. In addition to the hardware problems, which have already been presented, software presents some unique problems.

Microprocessors have two types of memories, random access memory (RAM), and programmable read only memory (PROM). Instructions consist of a fixed pattern of binary word patterns. Some instructions are permanently introduced into the microprocessor at the time that the chip is manufactured. Other instructions are introduced into the PROM at the final stage of automobile manufacture.

Employing these two methods, a manufacturer might have a microprocessor developed for all of its cars that uses the same basic set of instructions. Later a specific set of instructions could be added that would contain all the specific information relating to the specific engine, model, and options that characterize a particular car. The dealer or service center could also alter some particular instruction in order to correct an existing problem or to upgrade a system in an existing vehicle. All the instructions coded into the PROM are considered the software of the system and, as such, would have to be tested and documented.

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**If the auto industry  
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The testing function involves more than just testing the microprocessor. It involves insuring that the entire system and the vehicle that it is installed in are working properly.

Government legislation and product liability are also important testing factors. The EPA requires that auto manufacturers provide proof that their vehicles are built to maintain certain levels of emission control for a specific number of miles or years. Future legislation is likely to be more stringent and include areas of safety and economy considerations.

#### OTHER USES OF MICROPROCESSORS

The use of microprocessors in automobiles is not limited to ignition systems. Other areas under development include: cylinder selection, fuel consumption indicator, fuel injection, and transmission control, all of which can be considered to be emissions and economy considerations. Some of these can be incorporated into an ignition control system. For example, cylinder selection involves varying the number of cylinders employed at any one time to maximize fuel economy at different levels of speed, acceleration, and load.

As for safety, there are many microprocessor applications, some of which are very simple and others highly sophisticated. Among the more interesting include applications to check for low tire pressure, to monitor oil

level and battery charge indicators, to activate airbag actuators, to provide drunk driving prevention, and to monitor radar braking systems. The last two are of particular interest to the federal government. The drunk driving prevention device employs a gas composition sensor mounted in the steering wheel hub which prevents the ignition from working if the alcohol level in the breath of the operator is beyond a certain predetermined level. GM has done research on alcohol interlock systems and has produced devices that have effectively screened between 50% and 75% of drivers with blood alcohol concentrations of 0.1%.<sup>6</sup>

Automatic radar brakes is another application that the government is interested in. These systems automatically apply the automobile's brakes when the radar system detects a potential hazard to close to the front of the vehicle. The limiting factor in such a system is that it is difficult to differentiate between X-Band radar signatures of objects of different sizes and risk potentials. A possible solution is dependent upon the reduced cost of computer memory. If sufficient numbers of radar signatures could be stored, it would be possible to support a high-speed radar hazard analysis and automatically apply the brakes.<sup>7</sup> This system would function only as an emergency crash avoidance capacity activating when a crash is imminent and human interaction has not occurred. Other possible, but not probable, applications include brain wave monitoring devices that would wake up drivers who are falling asleep at the wheel. Also, anxiety and/or aggression interlocks could prevent drivers in an accident-prone frame of mind from being able to start the engine.

There are numerous other applications of microprocessors in automobiles, such as headlights, braking and electronic power control. Digital readout gauges are a logical extension of microprocessed engine control because most of the sensors and digital/analog interface units would be present in automobiles with engine control microprocessors. One problem with digital readout is that they are temperature sensitive, and automobiles are subjected to extreme temperature variation. Digital clocks, radio station indicators, and miles to empty fuel gauges have just become optional on high-priced American cars, and the trend is expected to continue as the costs are reduced.

## MAINTENANCE CONCERNS

The use of microprocessors in engine control and other automotive applications will certainly have widespread implications on the reliability and maintenance of the automobile. Currently, auto maintenance is designed to keep the vehicle running; in the future mere running will not be enough. As the purpose of microprocessed engine control systems is to allow a very high level of economy, environmental efficiency, and safety, maintenance will be directed towards maintaining those high standards. This will require high level diagnostic devices and mandatory periodic servicing.

While computer technology will contribute to the high cost and sophistication of auto servicing, it will not be its cause. The reason for the radical change in maintenance is society's insistence on high fuel economy, safety, and low emissions. If the auto industry were to meet strict standards by mechanical means, maintenance requirements would be more expensive as automobiles would require more servicing to meet the same standards.

A lag is likely in educating technicians in local service stations. Until advanced electronics are common and have been around for a while, it is likely that it will be difficult to find the qualified technician to work on your car. It is also likely that blame will be unfairly placed on

the microprocessor when the real problem will be that the mechanic is not familiar with the system.

Maintenance on the microprocessor equipped car must be compared with other cars that meet the 1981 pollution standards, not with today's vehicles. An alternative would be for Detroit to have gone another route (i.e., diesel, stratified charge, turbine, etc.) to meet the strict standards rather than to increase the sophistication of an existing but inefficient design. Whether or not these designs could meet the 1981 standards without a great many changes is not clear, but it is likely that they would require less in the way of electronics.

## CONCLUSIONS

Microprocessors will definitely be playing an increasingly important role in the automobile. Their use is just beginning and will probably become commonplace as a basic automotive component in the very near future. Because they are so new, many unanswered questions remain about their effect on automobile performance, reliability, maintenance, economy, and perhaps safety. There is no question that microprocessors will make the automobile a more sophisticated piece of machinery, and this will certainly have an impact on maintenance.

While the engine control function of a microprocessor will have little impact on the operator, there are many other applications such as safety, comfort, and convenience that could have a profound affect on the driver and his passengers. Unfortunately, these other applications are not likely to be microprocessed as quickly as engine control. As technology advances, more applications will become feasible. The possibilities are almost endless and will surely make the automobile of the 1980's quite different from the one that we drive today. □

## FOOTNOTES

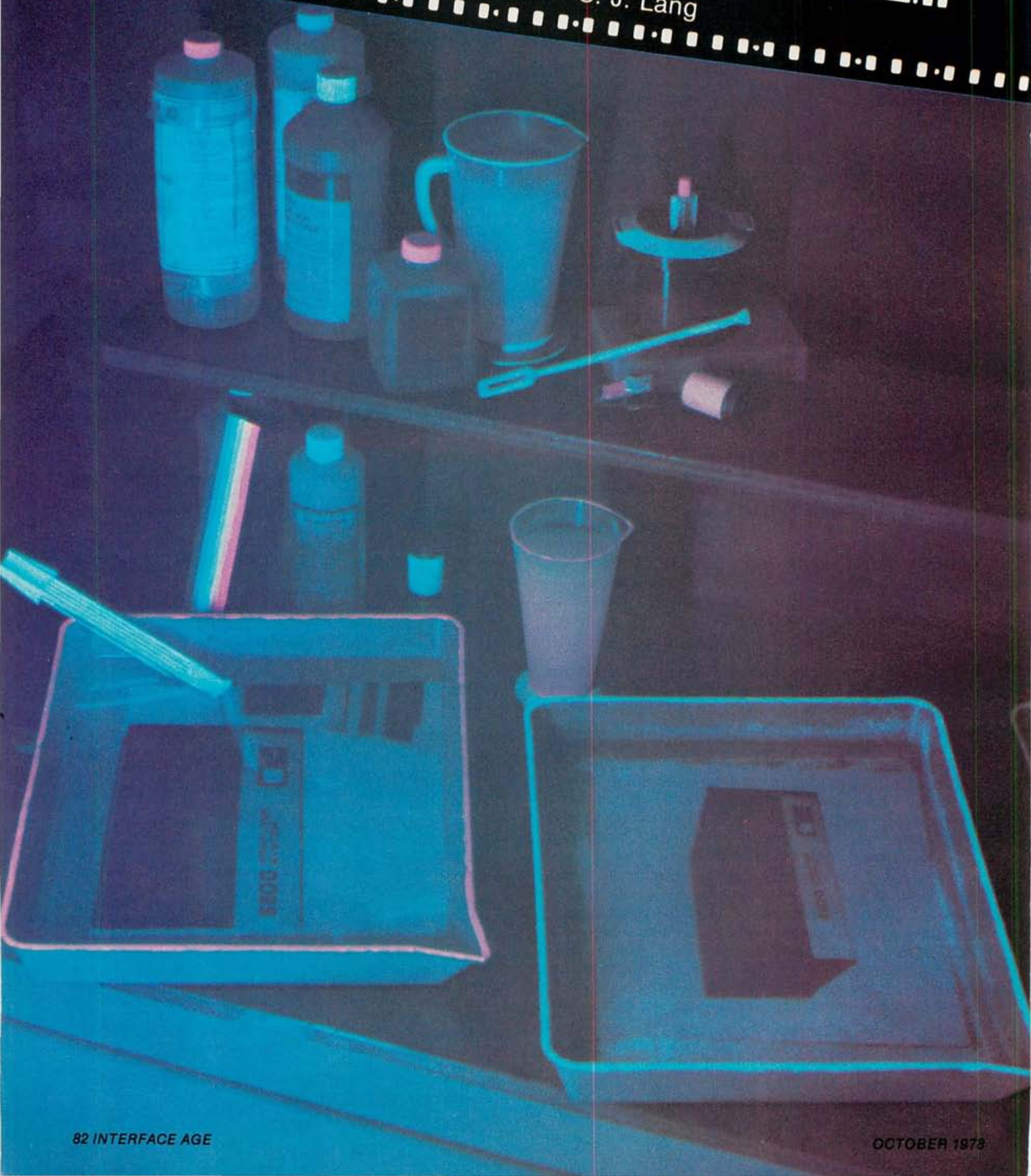
- <sup>1</sup>Trevor O. Jones. "Automobile Electronics I: Smaller and Better." *IEEE Spectrum*, (November 1977), p. 34.
- <sup>2</sup>E.F. Lindsley. "Buick's Turbocharged V6." *Popular Science*, (September 1977), p. 86.
- <sup>3</sup>Bernard M. Oliver. "The Role of Microelectronics in Instrumentation and Control." *Scientific American*, (September 1977), p. 183.
- <sup>4</sup>Ronald K. Jegen. "The Automobile: For Better or Worse." *IEEE Spectrum*, (November 1977), p. 32.
- <sup>5</sup>"Detroit's New Appetite for Electronic Controls." *Business Week*, (August 28, 1977), p. 64.
- <sup>6</sup>Trevor O. Jones. "Some Recent and Future Automotive Electronic Developments." *Science*, (March 18, 1977), p. 1159.
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# THE 6800 INVADES THE DARKROOM

By R. B. Lang, P.E. and C. J. Lang



Home computer enthusiasts are constantly looking for interesting applications for their investments. As newcomers to the field of photography, we found the precise temperatures and timing required in developing color prints a bit intimidating. A microcomputer acting as a prompter is a useful addition to the photo lab. Using a real time clock, the computer can not only beep when it is time to do something, it can tell you what to do (via teletype or T.V. typewriter). After the processing is over, the computer will even turn on the lights for you automatically. But if you aren't into photography, keep reading. The hardware and software presented here are applicable to any complex process lasting less than 99 minutes and in which timing is critical. There are many applications in cooking and labwork. You can even use it to wake yourself after that 10 or 15 minute catnap.

## HARDWARE

The basic hardware in our system consists of a SWTPC MP6800 computer with 4K, a SWTPC CT-1024 Video Terminal, an AC-30 Cassette Interface, and an MP-L Parallel Interface. The MP-L Interface is necessary for any type of real world interfacing. The SWTPC MP-L Parallel Interface consists of a Motorola 6820 Peripheral Interface Adapter Integrated Circuit (PIA) and the necessary buffering. Sixteen data lines are available for input or output along with 4 control lines. The parallel interface is plugged into I/O slot 0 in the SWTPC computer. Any slot may be used by changing the value of the constant PIA0 in the program.

Not being particularly hardware oriented, we tried to make the additional hardware for the computer prompter as simple as possible. The circuit was developed by experimentation on a breadboard out of spare parts lying around the workbench. The values of resistances and capacitances are not very critical. The values shown in Figure 1 work well.

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**A microcomputer acting as a prompter is a useful addition to the photo lab. . .it can tell you what to do (via teletype or T.V. typewriter). After the processing is over, the computer will. . .turn out the lights. . .**

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The operation of the hardware is as follows. A 60 cycle, 12 volt A.C. signal is taken from the computer power supply. The signal is conditioned and fed into the 74C08 CMOS "AND" Gate where it emerges as 60 Hz TTL pulses. The pulses are fed to the 7490 Decade Counter. The output on line 11 of the decade counter is a 6 Hz TTL pulse which is fed to C1 on the SWTPC parallel interface (CB1 Interrupt Input on the 6820 PIA). The peripheral input line CB1 is used to set the interrupt flag of the control register of the PIA six times a second. The interrupts are serviced six times a second by the software.

The rest of the circuit is a beeper that is controlled by the "A" side of the PIA. The input to the beeper is connected to 00 of the SWTPC parallel interface (Line PA0 on the 6820 PIA) and is controlled by the software. Of course, up to 8 output devices such as lights or beepers could be connected to 00-07 or 256 if multiplexed, but at the moment we are only using one beeper. The output signal from the PIA is buffered by passing through the 74C08. The signal is then used to turn the beeper, which

consists of the 555 Timer and its associated components, on and off. We determined that this buffering was necessary to prevent erratic and unreliable operation of the real time clock. An output of a hex byte "01" will turn the beeper on, and an output of "00" will turn it off.

## SOFTWARE

In writing the software, our two goals were to make the software as flexible as possible and to keep it as short as possible. The result is a program 235<sub>10</sub> bytes long with a data area following the program. Data is entered into the program in the format shown in the "comments" section of Program 1. The messages need not be input in their order of output. If an incorrect character is input in the message, it may be deleted by typing a "ctrl OD".

The program consists of three main sections. The first section starts with the label "BEGIN" and reads the times and messages to be output. A carriage return and a line feed are output. The minute and second of the first message are read in (assumed to be in decimal) and are converted to hexadecimal representation for storage. Data is stored sequentially beginning at address 010B. A 99<sub>10</sub> (HEX 63) signals the end of the input and the program jumps to the second section. If a 99<sub>10</sub> is not read, a hex byte is read after the seconds. This hex byte will later be output on lines 00 through 07 of the Parallel Interface. Next, the message is read one character at a time until it is terminated by a "ctrl D".

The beginning of the second section of the program is marked by the label "INIT" in Program 1. The second section does the outputting of messages at specified times. First, the real time clock is reset to zero. Next, the clock is started by the "CLI", clear interrupt instruction. The program starts to search the data area which begins at address 010A for a byte containing "04". An 04 marks the beginning of a data record. The next byte contains the minute that the message is to be printed or a 63<sub>10</sub>. A 63<sub>10</sub> signals that the end of the input has been reached and the program waits until the second changes and then restarts the search at 010A for a message to output. If a 63<sub>10</sub> is not encountered, the minute and second are compared with the current values of the real time clock minutes and seconds stored in addresses 0020 and 0021. If the times match, the third byte following the 04 is output to the A side of the PIA. This byte controls the beeper circuit. Next, a carriage return and a line feed are output, followed by the minute, second, hex byte and message that are to be printed. The time is converted to decimal representation before output. Next, a zero byte is output to the A side of the PIA to turn off the beeper. The program then waits until the second counter changes, then restarts the search for a message at 010A.

The final section of the program begins with the label "IRQ" and is the real time clock interrupt servicing routine. Six times a second, the clock pulse at C1 on the parallel interface causes bit 7 in control register "B" in the PIA to be set. This in turn causes the IRQ input line to the microprocessor to be grounded. Upon this interrupt signal, the Motorola MIBUG™ software causes a jump to the interrupt service routine indirectly through the addresses A000 and A001. These addresses have been previously loaded with 00E6, the address of "IRQ". Thus a clock pulse at C1 causes a jump to "IRQ" section of the program. First a check of bit 7 of control register "B" is done to determine that it was the clock that caused the interrupt. Next, bit 7 is cleared. The sixth of a second counter is incremented. If the counter is equal to 6, it is reset to zero and the second counter is incremented. Likewise, if the second counter is equal to 60, it is reset to zero and the minute counter is incremented. A return from interrupt is executed.

# C1 OF "B" SIDE OF PARALLEL INTERFACE

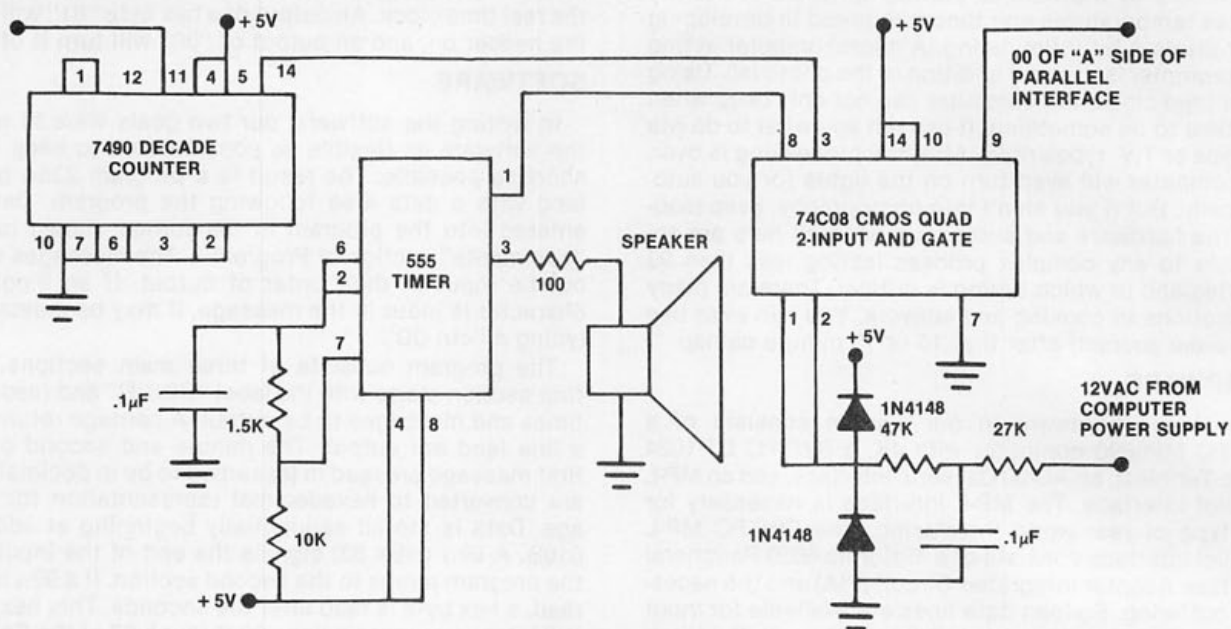


Figure 1. Real Time Clock and Beeper Circuit

## PROGRAM 1

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0000  TITLE ' - 6800 PROMPTER PROGRAM LISTING'
0001  * THIS PROGRAM KEEPS TRACK OF REAL TIME AND PROMPTS
0002  * THE USER WITH MESSAGES AT SPECIFIED TIMES.
0003  * WRITTEN BY R. D. LANG
0004  *
0005  * COMMENTS:
0006  * START PROGRAM BY STORING 0044 AT A040. TYPE G
0007  * DATA IS ENTERED IN FORMAT MMSSXXINSTRUCTIONS...ETC...99
0008  * WHERE MM=IS THE MINUTE AFTER START THAT MESSAGE IS PRINTED
0009  * SS=IS THE SECONDS AFTER START THAT MESSAGE IS PRINTED
0010  * XX=IS A HEX BYTE TO BE OUTPUT TO PIA0 WHEN MESSAGE
0011  * IS PRINTED
0012  * INSTRUCTIONS=IS THE MESSAGE (ANY LENGTH) TO BE PRINTED
0013  * 2=IS THE MESSAGE TERMINATOR (CTRL D)
0014  * ...ETC... ARE ANY NUMBER OF MESSAGES. TIMES 00 001
0015  * HAVE TO BE IN INCREASING ORDER.
0016  * 99=IS THE INPUT TERMINATOR.
0017  * (CTRL D) TO DELETE PREVIOUS CHARACTER IN MESSAGE
0018  *
0019  * AFTER INPUT TERMINATION IS READ, THE CLOCK WILL BE RESET
0020  * TO ZERO AND STARTED. THE MESSAGES ARE PRINTED AT THE
0021  * SPECIFIED TIMES. BEEPS, SIRENS AND FLASHING LIGHTS ARE
0022  * CONNECTED TO PIA0 (A SIDE).
0023  * TIMER PROGRAM CAN BE REHUP BY STARTING AT LOCATION 0060.
0024  * CLOCK INPUT IS CONNECTED TO PIA0(B SIDE) CBI
0025  *
0026  * **** MESSAGE ENTRY POINTS ****
0027  BYT EGU X'E055' HEAD HEX BYTE INTO A REG
0028  OUT2HS LDU X'E05A' OUTPUT HEX BYTE POINTED TO BY X REG
0029  PUTAT1 LDU X'E07E' OUTPUT CHAN. POINTED TO BY X REG
0030  *
0031  UNTIL 'X'04' ENCOUNTERED
0032  INTEL EGU X'E0AA' HEAD HEX NIBBLE INTO A REG
0033  INTEL LDU X'E0AC' HEAD HEX NIBBLE INTO A REG
0034  IM LDU X'E0AD' 10 INTERRUPT POINTER
0035  PIA0 LDU X'E0B0' PIA ADDRESS
0036  *
0037  PSELT X'E0C'
0038  MIN FCB X'E0' REAL TIME MINUTES
0039  *
0040  SEC FCB X'E0' REAL TIME SECONDS
0041  *
0042  SIXTH FCB X'E0' REAL TIME 1/6 SECONDS
0043  *
0044  CSIC FCB X'E0' CURRENT SECONDS
0045  *
0046  CR FCB X'E0' CARRIAGE RETURN
0047  *
0048  LF FCB X'E0' LINE FEED
0049  *
0050  LOT FCB X'E0' LOT
0051  *
0052  XSAVL FCB X'E000' RESERVE AREA TO SAVE X REG
0053  *
0054  DECI JSR NIBL CONVERT DECIMAL TO HEX FOR STORAGE
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```

004C 20      0096      BRA      ADD
004E 02      0097      NOTMIN INX
004F 08      0098      NOTSEC INX
0050 08      0099      ADD      LDAA X

0054 A6      0100      INX      CMPA +X*10* CHECK FOR BEGINNING OF RECORD
0055 00      0101      CMPA

0058 81      0104      BNE      ADD
0059 04      0105      LDAA X
005A 26      0106      CMPA +99 CHECK FOR END OF DATA
005B F9      0107      BEG      DEL
005C 00      0108      INX      CMPA MIN CHECK MIN OF ENTRY AGAINST CURRENLY MIN
005D 00      0109      BNE      NOTMIN
005E 00      010A      LDAA X
005F 81      0110      INX      CMPA SEC CHECK SEC OF ENTRY AGAINST CURRENLY SEC
0060 63      0111      BEG      DEL
0061 27      0112      LDAA X LOAD BYTE TO SEND TO PIA0
0062 08      0113      LDAB SEC SAVE CURRENT SEC COUNT
0063 00      0114      STAB CSLC
0064 00      0115      STAA PIA0 SEND BYTE TO PIA0
0065 00      0116      BSR      CHLP SUBROUTINE TO OUTPUT CR/LF
0066 00      0117      DEX      BACK TO SECONDS
0067 00      0118      DEX      BACK TO MINUTES
0068 00      0119      BSR      TIMPLP WRITE OUT MIN
0069 00      0120      BSR      TIMPLP WRITE OUT SEC
006A 00      0121      JSR      OUT2MS WRITE OUT DATA SENT TO PIA0
006B 00      0122      JSR      PDAT1 WRITE OUT MESSAGE
006C 00      0123      CLRA STAA PIA0 SEND ZERO BYTE TO PIA0
006D 00      0124      DEL LDAB CSEC
006E 00      0125      DEL LDAB CSEC
006F 00      0126      DEL LDAB CSEC
0070 00      0127      DEL LDAB CSEC
0071 00      0128      BNE      PEGU
0072 00      0129      BRA      DELAT
0073 00      0130      TIMPLP LDAB X OUTPUT TIME IN BASE 10
0074 00      0131      INX      STX XSAVE SAVE X REG
0075 00      0132      CLRA CMPB +10 BCD CONVERSION FOR OUTPUT OF TIME
0076 00      0133      HHI N2
0077 00      0134      ADDA +X*10*
0078 00      0135      SUBB +10
0079 00      0136      BRA N1
007A 00      0137      B2 ABA PSHA
007B 00      0138      TSX JSR OUT2MS
007C 00      0139      INS LDUX XSAVE RESTORE X REG
007D 00      0140      RTS LDAA PIA0+3 BEGINNING OF CLOCK INTERRUPT ROUTINE
007E 00      0141      BPL EXIT EXIT IF INTERRUPT FLAG IS CLEAR
007F 00      0142      LDAA PIA0+2 CLEAR INTERRUPT FLAG
0080 00      0143      INC SIXTH INCREMENT 1/6 SECOND COUNTER
0081 00      0144      LDAA +6
0082 00      0145      CMPA SIXTH
0083 00      0146      BNE EXIT IF SIXTH.NE.6 THEN EXIT
0084 00      0147      CLR SIXTH IF SIXTH.EQ.6 THEN RESET SIXTH TO ZERO
0085 00      0148      INC SEC AND INCREMENT SECONDS
0086 00      0149      LDAA +60
0087 00      0150      CMPA SEC
0088 00      0151      BNE EXIT IF SEC.NE.60 THEN EXIT
0089 00      0152      CLR SEC IF SEC.EQ.60 THEN RESET SEC TO ZERO
008A 00      0153      INC MIN AND INCREMENT MINUTE
008B 00      0154      EXIT HTI FCB END OF CLOCK INTERRUPT
008C 00      0155      END

```

```

000001**CIBACHROME**(ctrl D)
000200START BY POURING DEVELOPER INTO HOLDING CUP (ctrl D)
001001TURN TANK ON SIDE AND BEGIN AGITATION (ctrl D)
020001DRAIN DEVELOPER AND ADD BLEACH TO HOLDING CUP (ctrl D)
021001TURN TANK ON SIDE AND BEGIN AGITATION (ctrl D)
060001DRAIN BLEACH AND ADD FIXER TO HOLDING CUP (ctrl D)
061001TURN TANK ON SIDE AND BEGIN AGITATION (ctrl D)
091001DRAIN FIXER (ctrl D)
092001REMOVE CAP, WASH PRINT IN RUNNING WATER (ctrl D)
122001REMOVE PRINT, DRY WITH HAIR DRYER (ctrl D)
192001PRINT FINISHED! (ctrl D)
99

```

Figure 2. Sample Input for Cibachrome Processing

## PHOTOPROCESSING EXAMPLE

The system presented in this article is a general purpose timer and applicable to any short time process. We have found the prompter system very useful in doing photographic print processing using the Cibachrome\* process.

To run the program, begin by storing 0044 in locations A048 and A049. Type G to begin. Figure 2 is a listing of the input for the 12 minute Cibachrome developing procedure. Figure 3 shows a portion of memory after enter-

### ADDRESS CONTENTS

010A	04	00	00	01	2A	2A	43	49	42	41	43	48	52	4F	4D	45
	00	00	01	*	*	C	I	B	A	C	H	R	O	M	E	
011A	2A	2A	04	00	02	00	53	54	41	51	54	20	42	59	20	50
	*	*		00	02	00	S	T	A	R	T		B	Y		P
...	...															
0278	20	48	41	49	52	20	44	52	59	45	52	04	13	14	01	50
	H	A	I	R		D	R	Y	E	R			19	20	01	P
0288	52	49	4E	54	20	46	49	4E	49	53	48	45	44	21	04	63
	R	I	N	T		F	I	N	I	S	H	E	D	!		99

Figure 3. Hexadecimal Representation of Messages in Memory with Decimal or ASCII Equivalent Shown Below

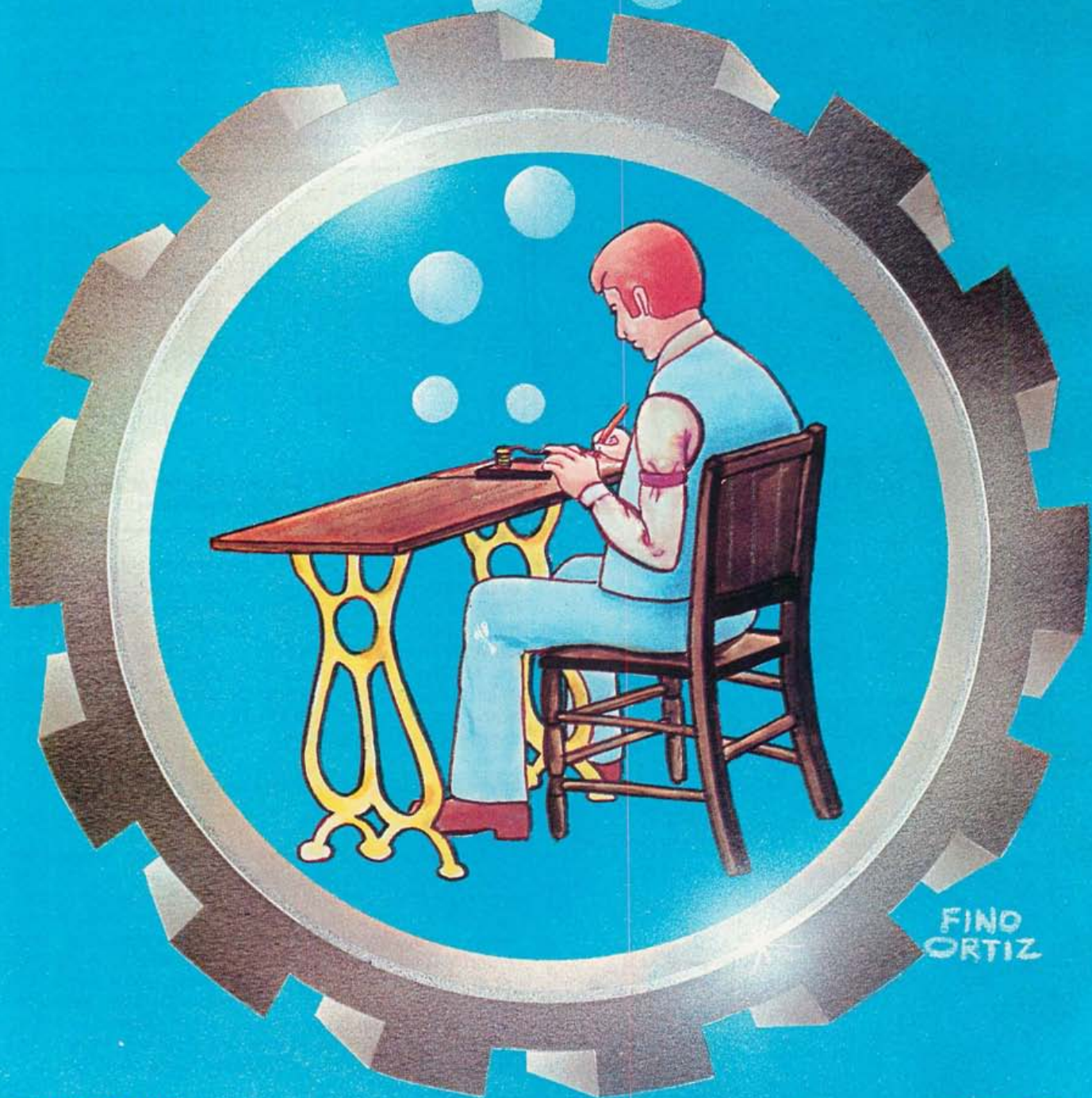
ing the input in Figure 2. To restart the program to process additional prints, just hit the reset button, load 006D in addresses A048 and A049 and type G. To save the Cibachrome instructions and the program on tape, set A002 to 00, A003 to 20, A004 to 2, and A005 to 97. Use the MIKBUG "P" command to save the program and data on tape. The program and data can then be loaded from tape using the MIKBUG "L" command and run using the restart instructions. □

Photograph on Page 82 by Shelley Wright

*\*Cibachrome is a simple process developed by Ilford for making color prints from slides. The "Discovery Kit", for less than \$20, contains all the supplies needed to produce 20 5" x 4" prints from your favorite slides. The Kit comes complete with an ingenious developing tank which allows the developing to proceed in a lighted room. The tank contains a holding cup which holds the chemical until the tank is turned on its side, at which time the chemical flows over the print. When the tank is uprighted, the spent chemical flows out a bottom drain, and the next chemical can be added to the holding cup.*

# Computer Generated Morse Code

By Jim McClure



For some time I have been interested in becoming a radio amateur and obtaining a General Class license. Unfortunately, the test administered by the Federal Communications Commission requires that a General Class radio amateur be able to send and receive Morse Code at a minimum speed of thirteen words per minute, not a natural ability by any means. I was reminded that "practice makes perfect" applied doubly to code, and the only way to learn it was to copy code sent by a proficient ham until I had mastered the required speed. Finding a proficient ham required me to look no farther than an Altair 8800 microcomputer.

The accompanying program, written for an 8080 microprocessor, accepts text from a console device and outputs the text to an audio amplifier as Morse Code. Since I am not a hardware type, the program was written to perform all necessary tone generation and modulation to simulate a code practice oscillator. All that is needed in the way of special hardware, beside the computer and a terminal, is a low-fi audio amplifier. While this program was intended for an 8080, it can be rewritten for other systems using the flowcharts presented with this article.

SPEED	DASHL Sets length of dash	DOTL Sets length of dot	SPACEL Sets delay between units	PAUSEL Sets delay between characters
5 WPM	80H	30H	0AH	0FFFFH
10 WPM	40H	10H	08H	070FFH
15 WPM	30H	0CH	06H	040FFH

Table 1.

When activated, the program prints a question mark on the console and waits for a line of text to be typed. (The rubout key will delete a previously entered character if a mistake is made.) After a carriage return is received, conversion from ASCII to Morse Code begins.

In addition to all upper case letters, the symbols for period, comma, semicolon, colon, and question mark are accepted by the program. Any other characters are ignored.

Conversion from ASCII to Morse Code is accomplished through a master table which contains an entry for each legal character. Each entry consists of two bytes. The first byte indicates the number of sending units (dashes or dots) for the desired character. Each bit of the second byte, read from right to left, represents a sending unit. If the bit is a zero, the corresponding sending unit will be a dot. Otherwise a dash will be sent. Figure 1 gives an example.

Table entry: Byte 1 = 00000010B Byte 2 = 00000010B

According to byte 1, we read two bits of byte 2 from right to left, generating a dot for the zero bit and a dash for the next bit since it is a one. This gives us the Morse Code equivalent of the letter 'A'.

Figure 1.

The tone generation portion of the program operates on the same principle as many of the popular no-hardware computer music synthesizers. The processor turns an output line on and off at a high rate, thereby generating a square wave of a frequency in the audio range. This line is then coupled to an amplifier, where the wave's level is boosted to drive a speaker. The output line is usually one bit of a parallel interface. However, all of my interfaces are serial type. Having no desire to buy or build a parallel port, I decided that the input to the audio

amplifier could be connected to the 'INTE' LED on the front panel of the computer by means of a .22 microfarad capacitor. This LED is lit whenever interrupts are enabled by the processor. This means that the LED can be turned on by executing an 'EI' (enable interrupts) instruction and turned off by executing a 'DI' (disable interrupts) instruction. Instead of modulating an output port, the program simply executes 'EI' and 'DI' instructions at a fast rate, causing the LED to blink, and thereby producing a tone for the amplifier. Of course, if a latching parallel interface is available, all this can be discarded by following the procedure detailed in Figure 2.

Replace all 'EI' instructions with:  
MVI A,1  
OUT address of parallel port

Replace all 'DI' instructions with:  
MVI A,0  
OUT address of parallel port

Connect audio input line in series with a .22 microfarad capacitor to bit 0 of your parallel port.

Figure 2.

All timing is controlled by four variables which are set at the beginning of the program to send code at about five words per minute. As receiving speed increases, the values of these variables may be adjusted to send at a higher rate. Table 1 lists the four variables and values for common speeds.

In order to run the program, two routines must be added which input from and output to the console device. The addresses of these two routines must be stored in the main program as follows:

0206H — Store low address of console input routine  
0207H — Store high address of console input routine  
0209H — Store low address of console output routine  
020AH — Store high address of console output routine

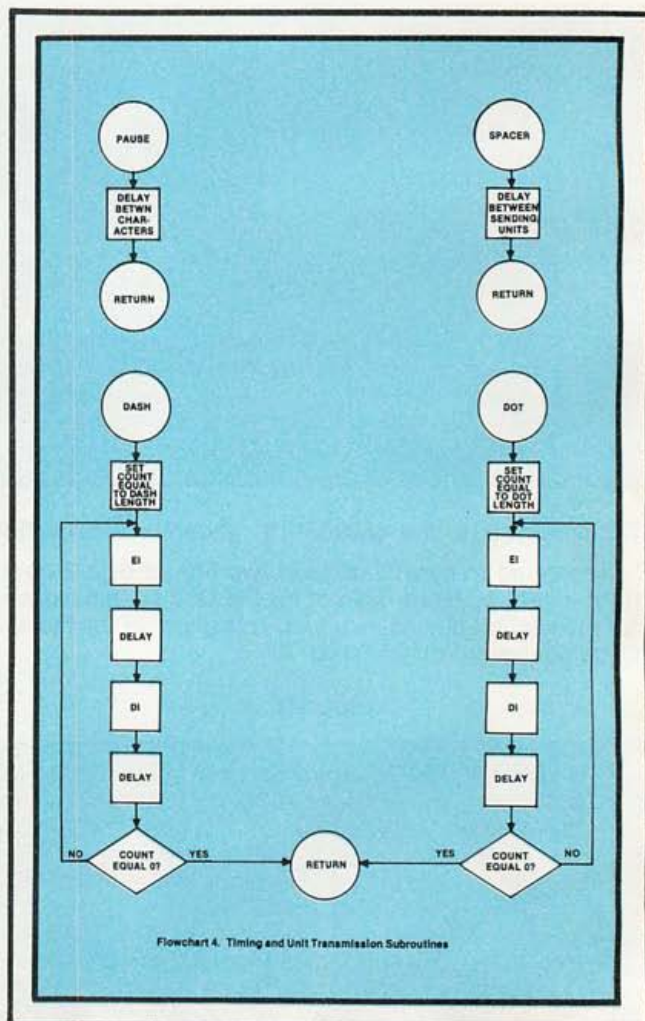
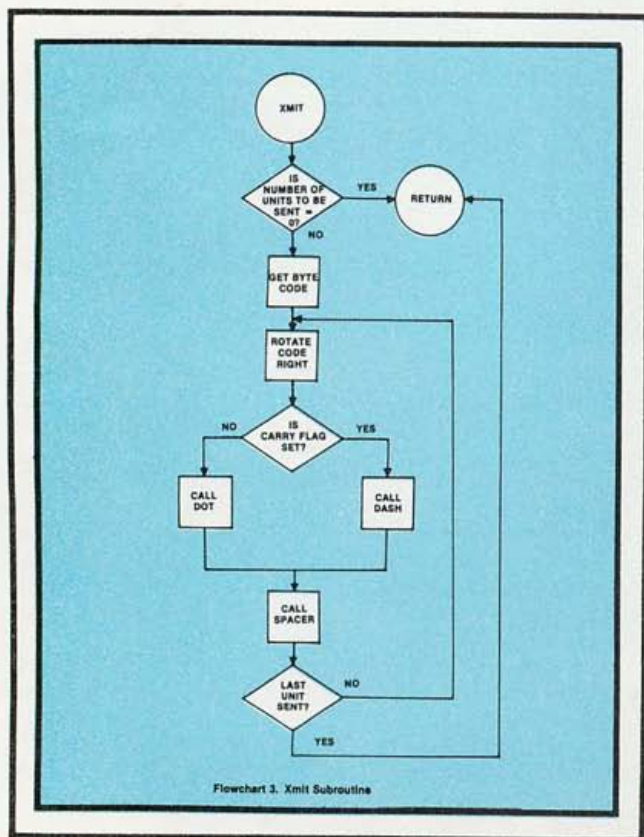
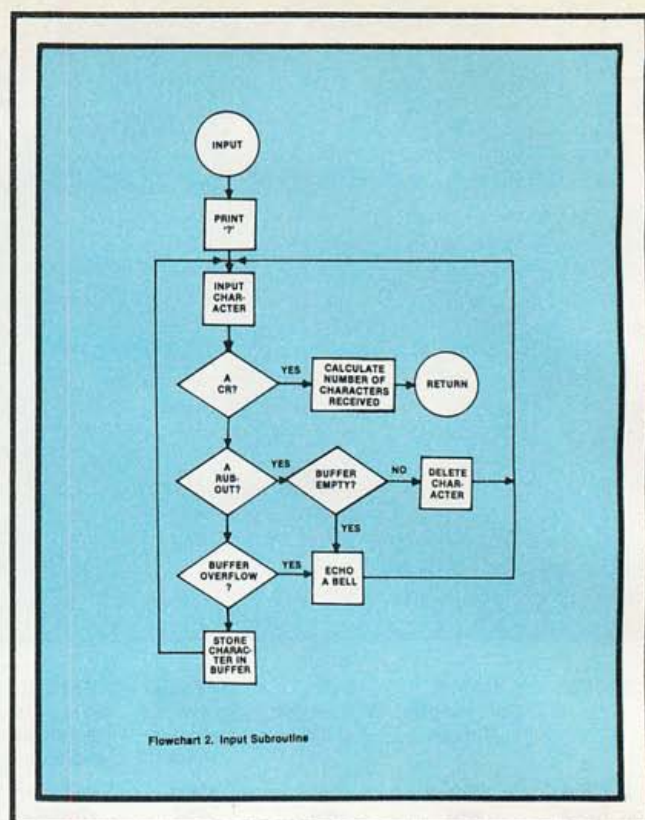
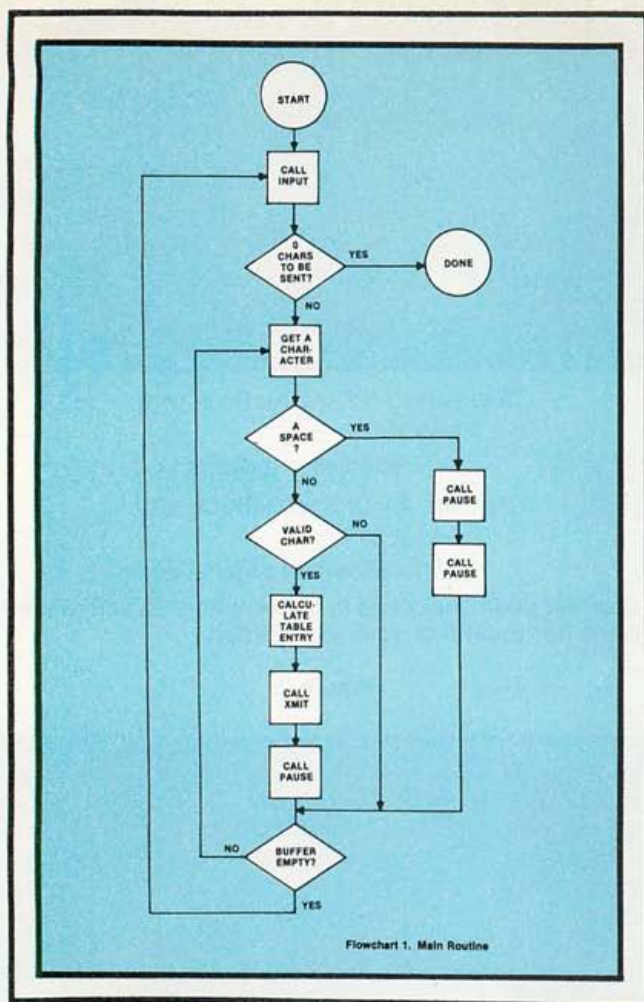
The input routine should return a character from the console in register A. The output routine should print a character from register C. No other registers are to be modified.

One last address should be added at locations 020CH (low byte) and 020DH (high byte). This is the address that the program jumps to when a carriage return with no text is typed in response to the question mark prompt. This address should be the entry point of whatever resident monitor is present in the system.

With regard to the hardware connection between the audio amplifier and the computer, the input cable (should be shielded) may be attached to the Display Control board of an Altair 8080A just behind the 'INTE' light and run out the back of the unit. If no front panel is available, a connection may be made to the S-100 bus at pin 28. Make sure that the amplifier being used has a fairly high input impedance so as not to load down any internal computer circuits, and don't forget the .22 microfarad capacitor between the computer and the amplifier. A good ground connection is also important to minimize hum and noise pickup.

If a parallel port is being used, the connection to the amplifier should be made according to the instructions given in Figure 2.

While all of this may seem like a lot of work, it goes quickly and yields surprisingly good results. You'll look far and wide before you find a ham who sends as smoothly as the computer. □



# PROGRAM LISTING

```

0000 = BUF EQU 00H ;TERMINAL READ BUFFER
0001 = SPACE EQU 20H ;SPACE CHARACTER
0002 = CR EQU 0DH ;CARRIAGE RETURN
0003 = LF EQU 0AH ;LINE FEED
0004 = BELL EQU 07H ;BELL
0005 = RUB EQU 7FH ;RUBOUT
0006 = PITCH EQU 000H ;SETS FREQUENCY OF TONE
0007 = DASHL EQU 00H ;SETS DELAY FOR DASH
0008 = DOTL EQU 30H ;SETS DELAY FOR DOT
0009 = SPACEL EQU 0AH ;SET DELAY BETWEEN SEND UNITS
000A = PAUSEL EQU 0FFFFH ;SET DELAY BETWEEN CHARACTERS
000B =
000C =
000D =
000E =
000F =

```

```

SENDB: CALL INPUT ;READ A LINE FROM CONSOLE
        LXI D,BUF
        ORA A ;CHECK COUNT OF CHARACTERS
        JZ DONE ;IF ZERO THEN QUIT
        MOV B,A ;COUNT OF CHARACTERS INTO REG. B

```

```

SENDL: LDAX D ;GET CHARACTER TO BE SENT
        MOV C,A ;SAVE IN REG. C
        CPI SPACE
        JZ PAUSE ;IF SPACE THEN PAUSE
        JZ PAUSE
        JZ SENDB ;AND SEND NEXT CHARACTER
        CPI 40
        JZ SENDB ;MAKE SURE IT IS VALID
        CPI 'Z'+1
        JZ SENDB ;ELSE SKIP IT
        JNC SENDB
        LXI H,TABLE ;SET POINTER TO CONVERSION TABLE
        PUSH D ;SAVE REG. D-E
        SUBTRACT LOWEST VALID CHARACTER
        RAL ;TIMES 2
        MOV E,A ;SET UP ADDITION
        MVI D,0 ;CLEAR D REG.
        DAD D ;POINT TO TABLE ENTRY
        CALL XMIT ;SEND THE CHARACTER
        POP D ;RESTORE POINTER TO BUFFER
        CALL PAUSE ;WAIT BEFORE NEXT CHARACTER

```

```

SENDB: INX D ;NEXT CHARACTER
        DCR B
        JNZ SENDB ;LOOP TIL BUFFER EMPTY
        JMP SENDB ;IF EMPTY START OVER

```

```

PAUSE: PUSH PSW ;SAVE STATUS
        PUSH D
        MVI E,2

```

```

PAUL: LXI H,PAUSEL
        DCR L
        JNZ PAUSE ;DELAY BETWEEN CHARACTERS
        DCR H
        JNZ PAUSE
        DCR E
        JNZ PAUL
        POP D
        POP PSW ;RESTORE STATUS
        RET

```

```

XMIT: PUSH PSW ;SAVE STATUS
        PUSH B
        MOV B,M ;GET NUMBER OF UNITS
        XRA A ;CLEAR ACCUMULATOR
        ORA B ;SEE IF REG. B IS ZERO
        JZ XMIT ;IF SO THEN DO NOT SEND
        INX H
        MOV C,M ;SAVE BYTE CODE IN REG. C

```

```

XMITL: MOV A,C ;GET BYTE CODE FROM REG. C
        ORA A ;CLEAR CARRY FLAG
        RAR ;TEST FIRST BIT
        DASH ;IF HIGH THEN SEND A DASH
        DOT ;IF LOW THEN SEND A DOT
        MOV C,A ;SAVE SHIFTED CODE
        CALL SPACER ;DELAY BEFORE SENDING NEXT UNIT
        DCR B
        JNZ XMITL ;LOOP UNTIL ZERO

```

```

XMITL: POP B ;RESTORE ALL REGS.
        POP PSW
        RET

```

```

DASH: PUSH PSW ;SAVE ALL REGS.
        PUSH H
        MVI H,DASHL ;DELAY FOR DASH

```

```

DASH: DI
        MVI L,PITCH ;FREQUENCY DETERMINING
        DCR L
        JNZ DASH ;NEXT CYCLE
        MVI L,PITCH ;MAKE SQUARE WAVE
        DCR L
        JNZ DASH ;MAJOR LOOP
        DCR H
        JNZ DASH
        POP PSW ;RESTORE REGS.
        RET

```

```

DOT: PUSH PSW ;SAVE ALL REGS.
        PUSH H
        MVI H,DOTL ;DELAY FOR DOT

```

```

DOT: DI
        MVI L,PITCH ;FREQUENCY DETERMINING
        DCR L
        JNZ DOT ;NEXT CYCLE
        MVI L,PITCH ;MAKE SQUARE WAVE
        DCR L
        JNZ DOT ;MAJOR LOOP
        DCR H
        JNZ DOT
        POP PSW ;RESTORE REGS.
        RET

```

```

SPACER: PUSH PSW ;SAVE ALL REGS.
        PUSH H
        MVI H,SPACEL ;PAUSE FOR A DOT
        SPACI:

```

```

01A6 2ED8 MVI L,PITCH ;FREQUENCY DETERMINING
01A8 2D DCR L
01A9 C2A001 JNZ S-1
01AC 2ED8 MVI L,PITCH ;FREQUENCY DETERMINING
01AE 2D DCR L
01AF C2A001 JNZ S-1
01B2 25 DCR H
01B3 C2A001 JNZ SPACI
01B6 E1 POP H ;RESTORE REGS.
01B7 F1 POP PSW
01B8 C9 RET

```

```

; BUFFERED INPUT ROUTINE
; TYPING A RUBOUT WILL DELETE THE PREVIOUSLY TYPED CHARACTER
; AND RE-ECHO IT. TYPING A RUBOUT WITH NO CHARACTERS ON LINE
; WILL ECHO A BELL. A BELL WILL ALSO BE ECHOED IF THE MAXIMUM
; LINE LIMIT OF 80 CHARACTERS IS EXCEEDED

```

```

INPUT: CALL CRLF ;ECHO A CR AND A LF
        MVI C,' ' ;DISPLAY PROMPT
        CALL COUT
        LXI H,BUF ;INPUT BUFFER
        MVI B,80 ;LINE LIMIT
IN1: CALL CINP ;GET CHARACTER FROM CONSOLE
        MOV M,A ;STORE IN MEMORY
        CPI CR ;SEE IF FINISHED
        JZ INPEND
        CPI RUB ;SEE IF A DELETE
        JZ RUBCHR
        INX H ;NEXT LOCATION
        DCR B ;CHECK COUNT
        JNZ IN2
        INR B ;IF LIMIT EXCEEDED
        DCX H

```

```

IERROR: MVI C,BELL ;ECHO A BELL
        CALL COUT
        INI ;AND GET NEXT CHARACTER

```

```

IN2: MOV C,A ;ECHO CHARACTER
        CALL COUT
        INI

```

```

INPEND: MVI A,80
        SUB B ;RETURN WITH NUMBER OF
        RET ;CHARACTERS IN REG. A

```

```

RUBCHR: MOV A,B ;CHECK COUNT
        CPI 80
        JZ IERROR ;IF ZERO THEN AN ERROR
        INR B ;ELSE
        DCX H ;DELETE LAST CHARACTER
        MOV A,M
        JMP IN2 ;AND RE-ECHO IT

```

```

CRLF: MVI C,CR ;ECHO A CARRIAGE RETURN
        CALL COUT
        MVI C,LF ;AND A LINE FEED
        CALL COUT
        RET

```

```

; JUMPS TO I/O ROUTINES

```

```

0205 C30000 CINP: JMP 00000H ;CONSOLE INPUT ROUTINE
0206 C30000 COUT: JMP 00000H ;CONSOLE OUTPUT ROUTINE
0207 C30000 BOOT: JMP 00000H ;MONITOR ENTRY POINT

```

```

DONE: CALL CRLF ;PRINT A CR AND LF
        JMP BOOT ;RETURN TO SYSTEM MONITOR

```

```

; TABLE OF LETTERS

```

```

TABLE: DB 6,101101B
        DB 6,101101B
        DB 0,0B
        DB 0,0B
        DB 6,110011B
        DB 0,0B
        DB 6,101010B
        DB 6,100010B
        DB 5,11111B
        DB 5,11110B
        DB 5,11100B
        DB 5,11000B
        DB 5,10000B
        DB 5,00000B
        DB 5,00001B
        DB 5,00010B
        DB 5,00110B
        DB 5,01110B
        DB 5,01111B
        DB 6,000111B
        DB 6,010101B
        DB 0,0B
        DB 0,0B
        DB 0,0B
        DB 6,001100B
        DB 0,0B
        DB 2,10B
        DB 4,0001B
        DB 4,0101B
        DB 3,01B
        DB 1,0B
        DB 4,0100B
        DB 3,011B
        DB 4,0000B
        DB 2,00B
        DB 4,1110B
        DB 3,101B
        DB 4,0010B
        DB 2,11B
        DB 2,01B
        DB 3,111B
        DB 4,0110B
        DB 4,0111B
        DB 3,010B
        DB 3,000B
        DB 1,1B
        DB 3,100B
        DB 4,1000B
        DB 3,110B
        DB 4,1001B
        DB 4,1101B
        DB 4,0011B

```

# BUSINESS EDITORIAL

By Rodnay Zaks

SYBEX, Inc.

## BUSINESS MICROCOMPUTERS: FRAUD OR REALITY?

Microcomputers have been widely advertised as being applicable to many type of small businesses. Within the last several months hardware costs have dropped below the \$10,000 mark, thus putting the prospect of automation closer to the small businessman's pocketbook.

With this decrease in cost has come, surprisingly enough, an extremely high degree of capability, or more correctly, probable capabilities. The essential question, however, is: do microcomputers offer total capabilities to the businessman today?

The answer to this question is an emphatic No! But to understand why, an understanding of where the business micro came from and what it is expected to do must be explored.

### FROM HOME TO BUSINESS COMPUTERS

An article in the January 1975 issue of *Popular Electronics*, by Leslie Solomon, revealed the existence of a low cost microcomputer available to hobbyists. The computer was, of course, the MITS Altair, based on the 8080 microprocessor. With the publication of the article came the beginning of what was projected to be a huge home computing market.

Within months, small companies were forming to fill the hardware gap, and no end appeared in sight. Yet three years later the hobbyist market has bottomed out and the industry is targeting to an even more promising market: the small business. However, with this market turnaround has come different problems for the manufacturers.

Businessmen cannot and will not tolerate the lengthy delays that so characterized the industry in its hobbyist days. Reliability has become an even more important factor; and, of course, cost.

Taking all of these problems into account, the industry has done well in providing solutions to meet delivery dates, and improving industry to end user relations.

But with improving the hardware and reducing costs, the microcomputer manufacturer has created yet another problem: that of representing current systems as the busi-

nessman's rosetta stone — the cure-all that will solve all the ills and management problems of ALL small businesses in the country. Is this a Fraud or a Reality?

## REQUIREMENTS OF BUSINESS COMPUTING

Automating any small business requires the availability of specialized files and file management programs for: accounts receivable, accounts payable, payroll, general ledger, inventory, tax, bank accounts, sales reports, and other reports, journals or ledgers that are important to a specific business type. To automate these types of activities offers a welcome benefit when time is of consideration. The results should be threefold: improved accuracy, almost instant availability of reports and statistics and a reduction in manpower.

However, to achieve all these benefits a method of file management must be established. This means that whenever a transaction is performed, all necessary programs or subsystems must be properly updated without performing extra entries of the same information.

For example, when a sales transaction is entered the customer and sales information are entered along with a billing date. On entry, the accounts receivable journal should be updated along with establishing a new record to the customer file. While this is taking place, or in sequence with, the inventory records are updated to reflect the notation that an item(s) have sold and are physically removed from the shelves. When the billing date is established, a shipping date may be in order which causes another sequence of events to take place.

Sounds complicated, but is only a direct reflection of what is done every day under manual methods.

Another requirement for business computer systems is that the differences between businesses must be taken into consideration. An accounting system that works well for a hardware store will probably be of no use to a book dealer or dry cleaning operation. Each business has different needs; even those businesses engaged in the same type of activity. Consequently, both the hardware — physical computer system — and software — the working programs — must be designed to fit the defined user's needs.

Flexibility is also essential in a business environment. Initially the needs of the business might be served by a number of simple software packages performing the traditional functions. However, it might quickly become desirable to add other customized routines to this set. Unless the competence exists in-house and all packages being utilized are fully documented, the task necessary to add the required additional facilities might become prohibitive.

The requirements of the small business are technically best served by a highly complex set of programs customized for the specific business. Clearly, this approach is not now realistic in view of the general unavailability of sophisticated software and the very high cost of programming relative to the cost of the hardware. Limitations in the value of the business programs will therefore exist.

## THE HARDWARE

Every microcomputer system first requires a box containing the microcomputer itself, i.e. the microprocessor board, the memory boards, any required interface boards, plus a power supply. In addition, the system requires a business quality printer, a CRT terminal and some form of mass storage.

The microcomputer itself often appears as the crucial choice in the selection of a business system. It is probably the least important one. The speed of the microprocessor itself is almost irrelevant. Because nearly all business systems are implemented in a high level language, the efficiency of the software interpreter or compiler which is used to execute this high level language is the item of crucial importance for the efficiency of the system.

There are naturally advantages and disadvantages inherent to each microprocessor. For example, in order to enjoy the possible benefits of standardized boards, any system providing an S-100 bus offers an advantage. It requires, in turn, an 8080 or Z80 microprocessor. However, provided that the sufficient set of peripherals be available from the start, the option to be able to add new fancy boards may be more appealing to the hobbyist than the business person, and other busses than S-100 might be equally acceptable. The choice of this beautiful microprocessor box may therefore be based on the established reputa-

tion of the manufacturer, its assumed reliability, or the possible advantages of its bus structure.

The hardware items which may have the most important significance for the businessman are by far the peripherals. It must be remembered that the cost of the peripherals will usually be the dominant cost in a system. Peripherals are likely to be usable over a significant period of time, whereas the microcomputer mainframe is likely to be obsolete in a short amount of time. It might be more valuable to invest time in the correct selection of the long lived expensive peripherals than in the selection of the mainframe.

## THE SOFTWARE

Software refers to all the programs necessary to make efficient use of the set of hardware resources available on a system. *At this time, no complete business software facility exists for microcomputers!*

Partial implementations exist and a number of simple packages are now available which will perform (usually separately) payroll, accounts receivable, general ledger, and other functions. However, the crucial task of simultaneous file management and sequential activation of selected programs is, as yet, not implemented. Such software solves business problems individually but does not provide the comprehensive facility needed for the efficient use of the hardware resources.

Because good comprehensive software is not yet available, microcomputers do not have the capability of solving all the business problems that are advertised.

## IS THIS A FRAUD?

Current software available for microcomputers makes them capable of solving a large number of tasks commonly associated with business accounting and bookkeeping. Because of the limitation in the automatic file handling capability of most of these programs, the computerization of these tasks may not result in any savings in terms of personnel. The entry of data for computer use tends to be longer and more complex than the manual typing of invoices or filling out of conventional forms. This is because a number of extra fields are required, and the entry format is highly structured. As a result, in most small companies computerization might require somewhat more manpower than less.

In addition, the possible unreliability of hardware and software components might result in catastrophic system breakdown. Every small busi-

ness owner will fully realize the computer "down" at the time that payroll checks should be generated, especially when the data needed has been saved on a single disk file which has just been wiped because of "accidental" error. These drawbacks are real.

## THE REAL ADVANTAGES

The real value of contemporary microcomputer systems, with their limited software, lies in two areas: management education, and future savings.

Every user of new and complex machinery must spend a significant period of time to learn the skills necessary to evaluate and control it. Therefore, it is considered highly advisable to practice on a used computer, rather than the expensive new one, the first time around.

With the introduction of computers in a business, a phenomenon known as computer shock occurs. The radical change of procedures required by computer programs often causes personnel to leave, rebel, or otherwise lose their efficiency. Similarly, catastrophic initial failures are likely to occur in the form of data being wiped out or not being produced at the right time.

However, because of the limited cost of microcomputers today, a heretofore unknown opportunity exists for the business owner to familiarize himself and his employees at minimal cost with this new technique.

In summary, microcomputers today offer the capability to learn business computerization at a modest cost. In addition, they have the potential in specific situations to bring modest or sometimes significant savings in the case of business expansion. Finally, they may be able to supply business capabilities which were simply not existent before.

For these reasons, current microcomputers are likely to pay for themselves several times over in direct business benefits as well as education for the business owner. They are far from having attained the true business automation capabilities which larger computers have demonstrated so far and should not be presented as such. Business microcomputers are a reality. The realistic evaluation of their limitations is also a necessity. □

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IMMEDIATE DELIVERY

## ALPHA MICRO ACCOUNTING SOFTWARE

A generalized interactive bookkeeping and accounting system created by our staff of Certified Public Accountants for our accounting practice.

This system has been in constant use during 1978 with numerous clients covering a wide range of business and non-profit activities. The PJA accounting system is a complete accounting system and includes the following subsystems: *Accounts Payable, Accounts Receivable, Cash Disbursements, Cash Receipts, Financial Statements, Fixed Assets, General Ledger, Inventory, Payroll and Sales.* We plan for future updates to contain the following subsystems: *Medical and Professional Billings, Job Costing and Work in Progress, Order Entry, EOQ Purchase Orders.*

The entire system is menu driven and chained together allowing the user to execute all functions without leaving the PJA system's control. Advance CRT menu screens are used throughout, permitting the use of personnel less familiar with computers and accounting. Data entry defaults and edit controls are used whenever possible to increase accuracy and productivity. In addition, all subsystems are interfaced with the general ledger thus eliminating the need to enter data more than once.

The complete package and documentation is available for \$2500. Updates will be provided to all users at a cost of \$25.00 per update.

This system requires an Alpha Micro computer system, minimum of 48k of memory, CRT, printer and dual floppy disk drive.

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DEALER INQUIRIES INVITED

Most literature in the computer field today is geared towards people who have a great deal of familiarity with computers. The literature is not geared towards people who are business oriented. Most of the applications for computers in the coming years are going to be for the businessman. The purpose of this article is to help bridge the gap, and to make computers and computer applications understandable to the businessman.

We will discuss what use the computer has to a business and will show how a computer fits into an overall business operation. Figure 1 shows the fundamental concept of what a computer does. The input to the computer is data. Examples of data would be: Joe Dokes paid \$10 for a dozen golf balls this morning, we just paid a \$214 phone bill, or Tom Harris made a \$240 sale to the Jones Lumber company. Data such as this goes into the computer. The computer correlates this data, rearranges it and combines it into a useful form. The output of this would be information. Information for our purposes here is simply correlated data, classified data, or summarized data.

Figure 2 shows how a computer fits into an overall business operation. The manager or owner of a business, of course, is at the top of an operation, and the diagram shows data going into the computer from the manager and also from the organization itself, the organization being composed of individual people. The diagram also shows information going back to the manager, to the organization or the people in the organization. The computer in no way eliminates the communication that takes place between the manager and the organization.

If you look at a typical business operation, you will

find they are inundated with paper work, phone calls, etc. If the paper work and phone calls reach a sufficient volume, the business can get to a point where one can't see the forest for the trees, and instead of proceeding in an orderly fashion, the manager and the organization itself can be operating in a mode where it just handles the first emergency that comes up.

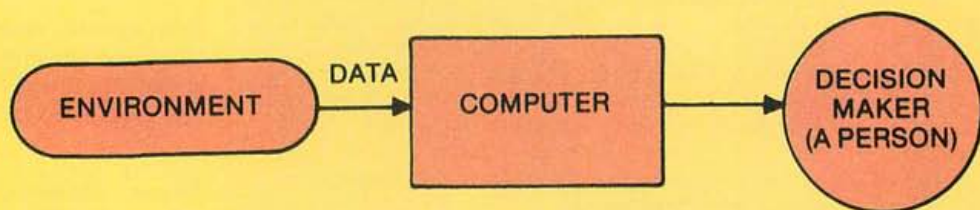
A computer itself is not going to put order into any such confusion in a business. When a business decides to get a computer, the preparation that is involved in order to install the computer forces discipline on the business itself. The computer has to have things presented to it in a very precise manner in order to operate at all. The mere act of getting ready to install a computer system can put enough order into the business and increased its efficiency to such a point that it more than pays for the cost of the computer system.

Take another look at Figure 2. Figure 2 shows that the computer makes information available for the manager of the organization and also to the employees of the organization. This increased availability of information should make the organization more productive, should increase the availability of its products and should smooth out the interaction of the organization with its environment — its customers, its vendors, and the people in the neighboring community.

Figure 3 shows the menu for the Business Management System that we use on the AM-100 computer. A menu is simply a list of options. We will go through these options and briefly describe what each one does.

# Overview of A Business Computer System

By James W. Kitzmiller



**Figure 1. Fundamental action of a business computer system.**

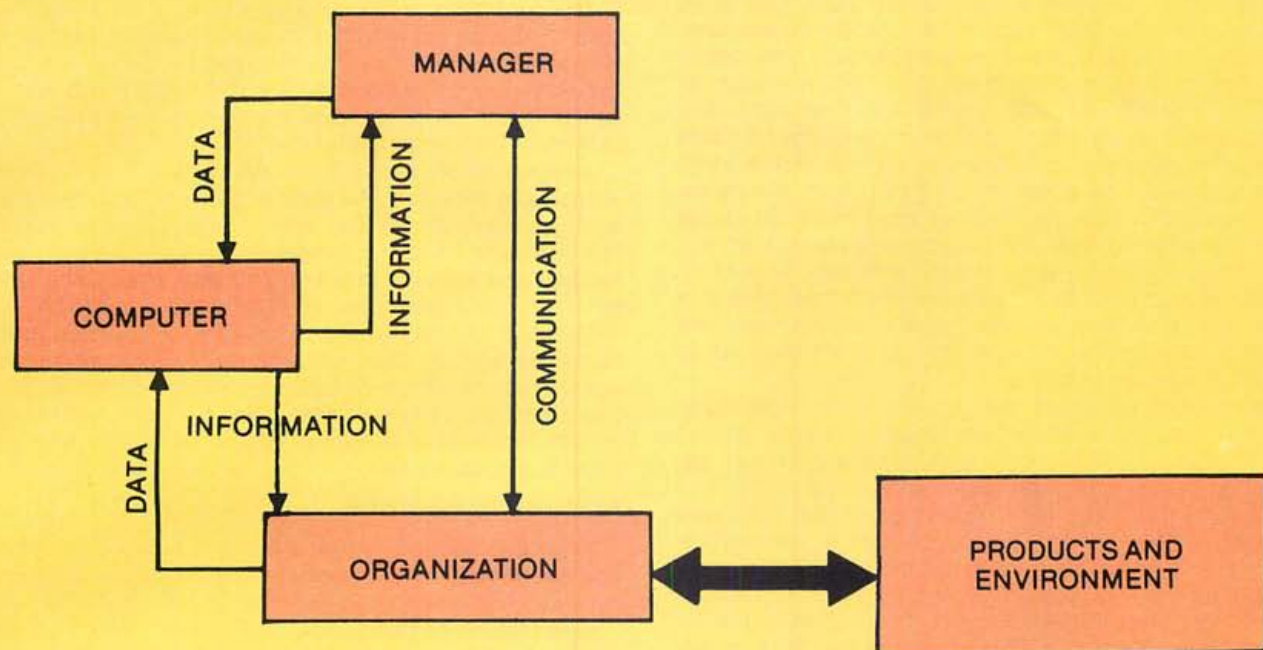


Figure 2. Use of a computer in a business.

WHICH WOULD YOU LIKE TO DO?

- 0 END
- 1 ORDER ENTRY
- 2 INVENTORY CONTROL
- 3 SALES ANALYSIS
- 4 ACCOUNTS RECEIVABLE
- 5 ACCOUNTS PAYABLE
- 6 GENERAL LEDGER
- ?

Figure 3. Menu for the AM-100 Business Management System.

### ORDER ENTRY

Option number one is order entry. Order entry is the process of telling the computer that a customer has bought a certain item or set of items from your business. The data that you would feed into the computer for

an order entry would be the same data that your salesman would put onto a sales slip when he making a sale; this data would be who the customer is, and his address. You would also include the name of the salesman as well as what item is purchased, how many of that item, and what the sales price is as well as the total price. Please take note that this order entry provides data to the computer so that the computer in a separate action can provide information to the organization and to the manager.

### INVENTORY CONTROL

Inventory is the collection of products that a business has for sale to its customers. Inventory control is the process of keeping track of how many of those items you have, when it's time to get more, where they are stored, how fast they are selling and so forth. The inventory control section of our AM-100 Business Management System performs a number of different functions. One is the actual process of entering data into your inventory data files on the computer. This is the act of providing data to the computer. Data that you enter would

be a part number for each item, a description of each item, name of the vendor who provides that item to your business, the purchase price for that item, the sales price for that item, how fast you sell that particular item, how many of those items you have in stock, how long it takes you to get that item from the time you place an order for the item until you receive it, and so forth. The inventory record also shows how many of those items you have in stock and also how many of those items you have ordered but have not yet received. Also, the inventory record contains data about how many of those items are back-ordered. Back-ordered means that you have made a sale to a customer but were unable to deliver the item right away because you did not have it in stock. The inventory control system would have the ability to allow you to add all of this data into the files as well as change any of this data.

The AM-100 Inventory Control System produces many reports. The first such report is an Inventory Status Report. That simply lists all of the data that was described above for each individual part in stock.

The Inventory On Order Report gives the business manager, salesman or purchasing agent information about which items have been purchased by the company but have not yet been received.

The Inventory Shortage Report gives a list of the inventory items that it is time to purchase. This is different from being out of an item. The computer program takes into account the fact that the items are being used at a certain rate and the fact that there is a certain time period from the time that an order is placed until the item is actually received. The Inventory Shortage Report gives a list of the items which should be purchased at this time from the vendors.

Another option of our AM-100 Inventory Control System allows the purchasing agent for the business to select which of the items to order at this time. He will use knowledge of the availability of cash and credit in order to determine which of those items should be purchased.

Another section of our Inventory Control System is the Physical Inventory Checklist. This is a list of inventory items printed on an 8½" x 11" sheet of paper that allows a stock clerk in the organization to go around and take a physical count of how many of each item are in stock. The result of this physical inventory will be used to make any corrections of errors in the inventory count that is stored on the computer itself. For example, if the computer says you have five items in stock but the physical inventory count shows there are only four, the business owner can correct the data that is stored on the computer.

Another inventory report is the Inventory by Value Report. This report shows the dollar value of each inventory item in stock. For example, your merchandise was worth a dollar each, and you have four of them in stock. It would show the item, four dollars worth of value; it also lists how many and the cost of each one. The computer sorts this data in to the order of total value for each type of item, so that merchandise of greater value would appear before that of lesser value.

Another feature of our inventory control system allows the user to print purchase orders. Rather than printing these purchase orders on a special type of form, we simply print them on a blank 8½" x 11" paper so that the user does not have to buy any special forms.

## SALES ANALYSIS

A sale is the transfer of ownership of a company product to a customer and receiving monetary exchange. Analysis is the act of breaking something down into its parts.

The Sales Analysis part of our Business Management System performs three different types of Sales Analysis.

The first type is Sales Analysis by Salesman. This lists the dollar value of the sales for each salesman. Information such as this can be used by the sales manager to see which salesmen are doing the best, and he can find out which actions these salesmen are taking that make them successful.

Another report of the Sales Analysis System is Sales Analysis by Product. The business owner, business manager, or sales manager can tell which products are moving the best, and he can emphasize sales of that particular product and increase production in that area; he can also tell if sales of a particular product have dropped off.

The next section of the sales analysis system is the Sales Analysis by Customer. This allows the sales manager to determine which customers are buying the most. The sales manager can then create a sales plan to approach that kind of customer with additional products in order to increase sales.

## ACCOUNTS PAYABLE

Accounts payable is just a list of the people to whom you owe money, and it tells you how much you owe each person.

One feature of our Accounts Payable System is vendor file maintenance. Maintenance is the act of keeping up to date. A file is a collection of data records like a card file. A vendor is a person from whom you buy products. You can maintain the data about vendors through this section of the Business Management System. A record is a set of data about a particular item. You might keep a record on a 3x5 card. The system allows you to add records to the vendor file, delete records, change records, list vendor records on your terminal or list vendor records on the system printer.

The major report of the accounts payable system is the Aged Payables Report. This is just a list of the bills that you owe by age with the oldest bills listed first on the report.

Another report is the Accounts Payable by Vendor Report. This just lists how much you owe to each vendor.

Another section of the Accounts Payable System allows you to select which bills to pay at this time. The dollar value of these bills is subtracted from the cash on hand, and the fact that you have paid those bills is entered into the Accounts Payable System.

## ACCOUNTS RECEIVABLE

Accounts Receivable is a list of who owes money to your company. It operates very similarly to the Accounts Payable. The first feature of the Accounts Receivable system is the Customer File Maintenance. This allows you to add customer records, delete customer records from your list, change data in the customer file, print out the customer records on the user terminal and print customer records on the system printer.

Another feature of the Accounts Receivable System is invoicing. Whenever an order is placed by the Order Entry System, the data is prepared so that invoices can be made and sent to the customer. These invoices are printed on standard 8½" x 11" paper, and the customer's name and address is inserted on the invoice at a position where it will appear in a window envelope. Your company name and address will appear on the invoice; the computer will print this for you.

The AM-100 Business Management System Accounts Receivable Section also will print statements for you. Once a month or as often as you choose, the system will

accumulate records of all unpaid bills owed to you and send out statements to each individual customer.

## GENERAL LEDGER

A ledger is a book where you keep records of various ways that your business took in money, spent money, and it also lists various things that your business owns and the various places where your business owes money. There is a separate page for each type of expense or each type of income and so forth. A general ledger is a book of this type.

The General Ledger System allows you to tell the computer where you received money or where you spent money and how much; it also allows you to tell the computer how much dollar value there is on each thing that you own, such as your office furniture or your office building. You can also tell the computer how much money you owe on various things, such as the mortgage on your building. All this is the data input to the General Ledger.

The General Ledger System consists of numerous reports. One such report is simply a concise printout of the data that you entered into the computer.

Another report is a listing of each of the various areas or categories that you used to define the assets of your business, your income, expenses and so forth, and it lists how many dollars you have allocated in total to each of those areas. Another report is the Profit and Loss statement sometimes referred to as an Income Statement. This just shows you how much money you have made over a specified time period, such as the month or the year.

---

**This information enables the  
business owner and the employees  
to act in a co-ordinated fashion. . .  
and do co-ordinated planning. . .**

---

The General Ledger makes a report called the Capital Statement. Capital is the net worth of the owner of the business or the net worth that the stockholders have in the corporation. A Capital Statement shows the increase in net worth over a given time period.

Another major report of the system is called the Balance Sheet. The balance sheet shows all of the assets of the business according to category; it lists all of the liabilities or money owed by the business; and it lists the capital of the business all according to the fundamental accounting equation: assets equals liabilities plus capital. So the balance sheet details each of those categories where the assets are, where the liabilities are and where the capital is.

## CONCLUSION

This is just a very brief overview of what a computer system such as AM-100 Business Management System does. Basically, the business owner and his employees feed data into the computer and get out information. This information enables the business owner and the employees to act in a co-ordinated fashion.

No computer system is going to do the thinking for the business manager or his employees. The computer will give information to the manager, and the manager with his judgement and perception of the environment will use this information to make the correct decisions. □

## GLOSSARY

<b>Account</b>	A category (type) of income, expense, asset, liability, capital, etc.; a record of activity in such a category.
<b>Accounting</b>	The process of recording, categorizing and summarizing data into a useful form. Although it is usually concerned with finance, the same concepts apply to other areas.
<b>Accounts Payable</b>	A list of the people who are after your money.
<b>Accounts Receivable</b>	A list of the people who owe you money.
<b>Analysis</b>	The act of breaking an area into smaller parts and learning more about the area by studying the parts.
<b>Computer</b>	A device that reads in data, stores it, rearranges, makes computations and tells you the results.
<b>CRT</b>	The TV type screen with the keyboard. (Abbreviation for cathode ray tube — an electronics term.)
<b>Data</b>	Records of details of events that have taken place.
<b>Environment</b>	Surroundings including customers, prospects, competitors, the neighborhood, and the prevailing laws.
<b>General Ledger</b>	A ledger used for accounts of a general nature. There can be "non-general" ledgers such as an accounts payable ledger.
<b>Information</b>	Data that has been aligned, categorized and/or summarized.
<b>Inventory</b>	Items in stock that are to be sold.
<b>Inventory Control</b>	The process of keeping track of the purchases, storage and sales of inventory and using that information to optimize purchasing schedules and quantities.
<b>Journal</b>	A place where you record transactions. In manual accounting systems, a journal is a book.
<b>Ledger</b>	A recording of accounts with records of each account kept in a separate area. Usually a ledger is in the form of a book. Each page contains information on a particular account.
<b>Menu</b>	A list of choices such as in a restaurant. The menu appears on the computer screen.
<b>Order</b>	A request from a customer to purchase your products.
<b>Order Entry</b>	The act of informing the computer that you just made a sale. It includes details of the sale.
<b>Product</b>	That which is brought into existence by your company and can be exchanged with the public for money or other means of survival.
<b>Sale</b>	The act of causing someone to buy your products and receiving a monetary exchange.
<b>Sales Analysis</b>	The process of studying sales when categorized into areas such as territory, type of product, type of customer, or salesman.
<b>System</b>	A set of machines, people and/or policies arranged to produce a desired product.
<b>Transaction</b>	An interchange such as a sale or a purchase.

# The Automated Attorney

By Mathew Tekulsky

Tom Lambert's Century City, California law office, which specializes in aircraft accident suits, has no full-time secretary. Instead, there's a microcomputer sitting in the corner. With this computer Lambert feels his office is "on the leading edge of the frontier in this particular use of office equipment. Computers are getting into a price range that relatively small law offices can afford, and the capabilities of the machines, if used efficiently, make the law practice of a much higher quality."

This means a lot more than just typing letters, as the computer has captured the central role in Lambert's three-man law office. One function of the microcomputer is the analysis of pertinent data in pending cases. For example, there is a family of three or four programs that are designed to calculate "the dynamic rollover" phenomenon of helicopters and to make a general quantitative evaluation of a sudden loss of tail rotor thrust.

"The program is basically an inquiry into the ground handling stability of any helicopter on any particular type of terrain," Lambert explains. "When we put in the specific data for a particular helicopter, it told us in effect that we had neither a dynamic rollover nor a ground pitching instability condition operative to cause the helicopter accident that we were working on. We use it as an exploratory tool and it's somewhat unique to our office."

But then, it's office is somewhat unique. All three lawyers are professional pilots, and two out of three are mechanical engineers by trade. Consequently, they do the bulk of their research in-house. Once they understand a problem, they go to outside experts for confirmation, review and preparation of expert testimony for the trial.

Another family of programs which Lambert developed involves building a mathematical model of applied loads for the "tail feathers" of a helicopter which had been involved in an accident, and then relating that to the actual loads of the components that broke.

Lambert explains how it works: "We calculated each of the failure modes of the component, and then another program compared the applied load to the resulting failure mode. As soon as a resulting failure mode occurred, it would plot a data point. This gave us a whole family of curves that told us which part of the system would fail first and what type of a failure it would be. Then we took the strength of the component and deteriorated it from 100% all the way down to 33%."

The 33% is significant because that is the FAA required margin of safety. For tactical reasons, Lambert did not use this information as hard evidence during a recent trial. However, it was very useful in the preparation of litigation.

His third family of programs is a damage evaluation analysis. "I've never really been totally satisfied with the accuracy of how actuaries prepare projected economic loss for wrongful death cases," Lambert says. "This family of programs is designed to assess the economic loss of the plaintiffs in wrongful death and personal injury lawsuits. It will also assess the value of the 'loss of companionship' in a wrongful death case and the 'pain and suffering' concept in a personal injury case."

The program itself contains certain variables such as the victim's vital statistics: age, the probability of survival to a particular age, and dates of birth and death. Then the computer estimates the individual's future rate

of earnings and rate of return on invested capital, takes a per capita basis of reduction for personal consumption, and whatever is left over belongs to the survivors.

The program calculates the loss of companionship in a wrongful death situation on a per diem basis, i.e. how much per day. It does the same thing with the pain and suffering concept in a personal injury case which, according to Lambert, can always be related rationally to some value of dollars over a projected period of time, usually starting high nearer to the injury and stabilizing over the individual's projected life span.

"The big advantage of using the computer for this type of evaluation is that you can do quantum jumps," says Lambert. "With this method, you look at each year in the individual's projected life span individually as opposed to taking an average over a life span. The result you're trying to find is the basic economic loss that is solidly, economically and factually justified."

Due to the diversified nature of aircraft accidents, which often involve international parties that must be treated on an individual basis, this program is extremely useful to Lambert.

"The variables that go into this are enormous, so we take the generalized case and apply it to specific situations," he says. "And something in a generalized format like this is particularly important when you get into situations in which you have a wide range of rate of return of invested capital. For instance, with people who are earning and investing their money outside of the United States, we have to look at the conditions that are applicable to them in order to determine how their families have been deprived by the loss."

"The difficult conceptual task here is to be able to foresee what the variables are in a generalized case for your programming, and then write a program that doesn't use up all your memory by taking into consideration variables that aren't needed. You want it to be as concise and crisp as possible, and you want to have it in a simplified format so you can use it and explain it to people who don't understand these concepts generally anyway."

This is the jury in many cases, although the information is useful from both the plaintiff's and the defense's point of view. For his output, Lambert employs a tabular format and a curve plot, the latter of which offers a graphic view of the validity of the data.

How does this work in court?

"Once you have the family of curves, you can have your economist come on and testify that the rate of interest in the future will most likely be a certain percent, allowing a little leeway on the low side and on the high side," he explains. "Then he could evaluate with some factual backup what the projected rate of application of earnings would be. At the point where these two parameters cross on the curve plot, you have defined a range of hard data as to what the projected economic loss to that individual is on the most rational and logical basis."

Another program that Lambert has just started writing is an attorney time-keeping system with features that permit adaptation to existing accounting systems and the immediate retention and recall of all information that's within a client's file. This would include how much time has been spent on certain cases, the aging of a client's account, and information pertaining to the preparation of periodic client billings.

As a result, billing will be easier and will show a continuous account of what has transpired in each case. This is cumbersome to do by hand and would otherwise have to be turned over to a bookkeeper.

In the area of word processing, Lambert has found many applications for his computer. "One of its very great features is the outlining capability," he says. "It's really good to sit down and organize your thoughts in outline form, hit the research, bring the results back and dictate the body of the brief for the secretary to type up."

The computer's text editing capability allows "Points and Authorities" (the legal terminology for "mini briefs" submitted to the court) to be stored on disks, edited and made applicable to the problem at hand. Lambert puts everything onto a disk initially, and after it's reviewed and edited, he decides whether it's worth saving. The computer can also save case captions (names of plaintiffs vs. names of defendants) which the secretary only has to type out once.

Lambert explains how all of this facilitates the writing of a legal brief: "With each new pleading, we just load in the caption and the rest of the pleading from some other file in pieces and in a certain order from the disk into computer memory. Then when we're all through, we can add something special or unique to it, edit it, and when we've got everything we want, we just put in a signature line and a date. That completes the document and we can save that in a case file by putting it into the disk under its own file name. Then we print out the hard copy, reproduce it and serve it. It's a much quicker way to perform the very tedious tasks that are normally required in this type of practice."

"The big advantage here is that if you have some small error in the middle of the text, you don't have to rewrite 15 pages. You just go back in, clean up the mistake, get back out of the edit mode and run out a new hard copy. It only takes about 10 minutes."

## THE SYSTEM

Lambert's system consists of a COMPAL 80 computer with 32K memory, a Multiterm printer, a 17" Sanyo television screen, a single disk Micropolis and a cassette tape recorder. The total cost is about \$8,300, which includes some supplies like print wheels and ribbons as well as two software programs: Micropolis BASIC and the WORDPAL word processor.

The Multiterm printer, he says, is comparable in price and quality to the Xerox Diablo, except that the former comes equipped with a forms tractor that would ordinarily cost an extra \$300. It also has a better graphics capability, but otherwise, "there's not a great deal of difference."

The reason he has both a cassette and a disk is twofold: first, he uses the cassette for a backup and second, much canned software available today comes in cassette form, particularly in the numerical area.

As far as software is concerned, Lambert has written over a dozen programs. In addition, he uses the WORDPAL to build text files which are saved and recalled in a variety of combinations. Owing to the somewhat unique nature of his practice, the computer's ability to handle both numerical analyses and text editing is its strongest attribute.

Lambert did not take any programming courses. He just studied the manuals, sat down and started writing. "I used to use basic programming when I was in the aerospace field," he states, "but there is still somewhat of a learning curve."

"If one is going to do the programming oneself, there's only one way to do it — roll up your sleeves, spend some time with the manual, spend some time writing programs and *do it*. Until you learn, you're going to use a lot of time that you may not have, and once you

get there, it's like flying an airplane — you have to stay current and proficient by updating, expanding and writing a new program every month or so."

The alternative to this, he says, is to go to a local university or computer club or go to your local computer store, hire a computer consultant, work out what the objective of the program is and have the consultant sit down and write it. This may or may not cost a great deal, depending upon the scope of the program objectives.

In terms of quantifying the value of his own programs, Lambert "wouldn't even know where to start."

"It's such a unique application, there may be no marketplace for it," he says, "and yet when you find a marketplace, your opposition may be willing to pay ten times the legitimate price for it to eliminate the surprise element."

Lambert has had his computer for about four months and although he is not taking advantage of every feature the machine has to offer, the computer was an improvement over his existing method within a week after the system was purchased.

"The WORDPAL part of the system is far and away the easiest to learn, and it's the quickest," he says. "The text editing can be learned by any competent secretary in no more than a week's time."

## THE REAL WORLD

Lambert offers some advice on how to obtain maximum efficiency with one's computer. "With the WORDPAL, the first order of business is to work out in advance a system of allocating your disks," he says. "It's very easy to save everything and fill up your disks, but if you have to go back and search each of the directories on 20 disks, you haven't really accomplished anything."

The disks are sufficiently inexpensive that if you're going to err, err on the side of having a few empty spots to fill up. We have assigned one disk for internal office use, another for numerical programs, which I'm expanding rapidly now into one disk for every major numerical family of programs, one for each major case and one for miscellaneous cases."

The next step, he believes, is to establish in advance a system of naming files, which only have 10 characters. Lambert's method, adapted from law library citations, uses two numbers followed by a dash, then three letters followed by a dash, and finally three more numbers or letters. For example, 32-CAP-1 identifies the first "caption" of case number 32. Each case has its own case number for the file name identification.

The greatest asset of the computer, according to Lambert, is "saving time."

"It's hard to say just how much we have saved, but it certainly has been substantial," he says. "We're now using just one high quality (and expensive) regular part-time secretary and a couple of others on an overload, part-time basis."

In addition, the computer adds to the quality of Lambert's law practice with its ability to produce perfect copies, and it helps him better understand the phenomena at play in particular accidents.

"Since much of our work involves reconstructing and understanding the reconstruction of aircraft flying machine accidents, including airplanes, helicopters and even hang gliders," he says, "if it does nothing more than help me to better understand the evidence so I can present it better, then it's done its job."

Indeed, Lambert's research into the ground stability phenomenon in helicopter accidents and other situations may represent a significant contribution to the aerospace community which can be attributed directly to his computer. □

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# Hard Copy: Why Not the Best? Go Daisywheel!

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By John MacDougall

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If you are thinking of word processing either for letter writing, for legal manuscripts or just for getting publishable assembly listings, you are also thinking about some kind of quality printer. One of the highest quality printers on the market today is the daisywheel printer made by Diablo and Qume. This printer mechanism has the advantages of speed (30 cps), variety of print fonts, variable line and character spacing, and finally, a mechanism which is extremely simple and very compatible with electronic interfaces.

Recently, these mechanisms have begun to appear on the surplus market at prices which are attractive to the serious hobbyist. There is very little published information about these printers although there seems to be a strong interest in their use. Over the last year and a half I have built a succession of daisywheel interfaces for my own use. This article describes the latest of these. The interface described here is the simplest driver reasonably possible for a word processing application. It has been in use for several months now and is eminently suitable as a "starter" system.

## DESCRIPTION OF THE PRINTER MECHANISM

The description which follows applies directly to the Diablo "HYTYPE I" daisywheel printer mechanism. This is the one I have and appears to be the only type on the surplus market. Recently, Diablo and Qume have both introduced microprocessor controlled printers of the same general mechanical characteristics. Interfacing with these is quite another story.

The HYTYPE I has a few moving parts. The first of these is the platen. This can be either a friction feed or sprocket feed device and can be controlled in  $\frac{1}{8}$  of an inch increments either up or down. The platen is driven by a gear coupled stepping motor.

The second moving part in the HYTYPE I is the carriage. The carriage is driven by a large servo motor which pulls it equally well in either direction with a loop of cable. The servo is a sophisticated analog/digital hybrid, and the carriage can be zipped the full width of the platen in less than 400 milliseconds. One of the advantages of this system is apparent in "tabbing" operations where the carriage literally jumps from position to position without the slow jogging of the usual stepping system. In these conditions the HYTYPE I can be faster than its rated 30 characters per second.

The third moving part in the HYTYPE I is the printwheel. This is driven directly by another small servo motor and is the only one of the moving parts which has positional memory. The printwheel mounts directly on the servo motor shaft and can be easily and quickly interchanged upon tilting the carriage mechanism back.

There are two other moving parts in the mechanism both on the carriage. The first is the hammer which strikes

the print wheel "petal" to make the type impression, and the second is the small stepping motor which pulls the inked ribbon.

The servo systems which drive the carriage and printwheel in the HYTYPE I are very sophisticated electronically. In addition, the system is interlocked electronically so that, for instance, the carriage cannot move while the hammer is striking the printwheel. A number of other functions are carried in the electronics, as we will see later, but the net result of all this is about a square yard of circuit board spread along the bottom of the machine and up the back. The boards are stuffed, for the most part, with standard TTL integrated circuits, with a few operational amplifiers and FET switches thrown in. The data input lines are loaded with 250 ohm pullup resistors and protected by diodes to +5 volts and ground.

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**...the eleven bit machine is simpler,  
and modification of the hardware  
and software. ...for the eleven bit  
machine is an easy reduction  
from the illustrated material.**

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The servo drives for the carriage and printwheel derive their high slewing rate from high current, high voltage power supplies. In the new HYTYPE II's the power supply is a switcher and easily fits within the frame of the printer. In the older machines on the surplus market, the power supply is a large conventional brute which weighs about 40 pounds and is hard to hide. Fortunately, the power supply has also appeared on the market at a reasonable price, or you would be faced with constructing a unit with  $\pm 15$  volts at 9 amperes and 5 volts at 5 amperes capability. It's worth buying since it also has crowbar short circuit protection and is interlocked to take all of the supplies down if one fails or is shorted.

HYTYPE I mechanisms are available on the surplus market integrated with a keyboard at about twice the price of the parts alone. If you are not willing to go to some trouble in constructing interfaces and software drivers, you had better stop reading and get one of the complete units. Just to emphasize a point, the extreme versatility of the HYTYPE I has the penalty that the driver software must do everything. For instance, the carriage movement is incrementally controlled, and it is up to the controller to remember the carriage position so that the correct data can be applied for the carriage return. Otherwise the carriage will probably crash quite happily, and at high speed, into the end stops.

The basic unit, unlike mechanically driven terminals, is entirely separate from the keyboard and only associated with it through the interface electronics. You thus have the option of making a complete unit or of using the HYTYPE I as a printer only (as I now do). Optionally,

\*"HYTYPE I" is a registered trademark of Diablo Systems Inc. Hayward, California.

if you want to make a complete terminal, you can use any reasonable keyboard of your own choosing. Although I don't use it, the interface described in this article has the provision for a keyboard input.

The data connections for the printer are shown in Table I. The data input is carried on eleven or twelve lines depending on which machine you bought. By far, the most common data bus is eleven bits wide. My machine happens to be one of the rare twelve bit machines. For interface the eleven bit machine is simpler, and modification of the hardware and software in this article for the eleven bit machine is an easy reduction from the illustrated material. The table shows my understanding of the meanings of the various data lines for the two types of data busses. If this doesn't seem to fit what you have, then you will have to contact Diablo with specific details of circuit board number and revision for further information.

**Table I. Data Connections for HYTYPE I™ Printers**

Connector Pin Designation	Signal (All signals active low)	Machine Character Print Data	
		11 Bit Bus	12 Bit Bus
<b>a. Input to Printer:</b>			
h	DATA 1	0	0
j	DATA 2	1	1
m	DATA 4	2	2
f	DATA 8	3	3 Character Code
k	DATA 16	4	4
i	DATA 32	5	5
g	DATA 64	6	6
d	DATA 128	X	R
b	DATA 256	X	R Ribbon Adv. Code
V	DATA 512	X	R
F	DATA 1024	X	H Hammer Pres. Code
L	DATA 2048	not used	H
C	Platen Strobe		
K	Carriage Strobe		
P	Print Strobe		
M	Ribbon Lift		
E	Restore		
S	Select Printer		
H	Select Ready Lines		
<b>b. Output from Printer:</b>			
a	Printer Ready		
B	Check		
R	Paper Out (only works if switch is added)		
c	Platen Ready		
w	Carriage Ready		
Y	Print Ready		
Z,n	Not to be used		

Note: "X" means "don't care"

Note: "X" means "don't care"

Data for the carriage movement and the platen are applied in a similar manner. The highest order bit determines the direction of movement, and the lower bits determine the amount of travel. Notice that this is not a two's complement or other similar mathematical number. It is very simply a positive number giving the distance of travel and a bit which determines the direction of travel. A "one" in the high order bit means carriage movement from right to left or a platen movement in the reverse direction to a normal feed line. The distance of travel indicated by the lower bits is a multiple of fractions of an inch.

In the twelve bit machines the fundamental increment is  $\frac{1}{120}$  of an inch horizontally and  $\frac{1}{48}$  of an inch vertically (platen). In the eleven bit machines the fundamental in-

crements are  $\frac{1}{60}$  of an inch for the carriage and  $\frac{1}{48}$  of an inch for the platen. All of the illustrations and examples in this article are for the twelve bit machines. For instance, if you wish to move the carriage the correct increment for 12 characters per inch, the calculation is done as follows:

$$\text{Number of fundamental increments} = \frac{\text{Number of basic increments per inch}}{\text{Desired characters per inch}}$$

Thus, for 12 characters per inch in a twelve bit system

$$\begin{aligned} \text{Data} &= 120/12 = 10 \text{ decimal} = \text{A hexadecimal} = \\ &= 0000\ 0000\ 1010 \text{ binary} \end{aligned}$$

This is exactly the data which would be put on the data bus. If the movement were for a backspace, the reverse bit would be set, and the data would appear as 1000 0000 1010. Similar reasoning applies for the platen movement.

The character data is different. In this case the code for the actual character is put on the data bus, and the printer has the necessary internal electronics to determine the print wheel movement needed to find the correct character. In the twelve bit machines the upper data bits also determine the amount of hammer pressure and the amount of ribbon advance. I have incorporated this in my software. The upper bits of the character data have no meaning in the eleven bit machines and can be ignored.

Notice that in all of this discussion, the same data bus is used no matter what the function. The function that the data performs is determined by the strobes. There are three strobe lines, and only one strobe line can be strobed at a time. However, the machine will remember, and it is possible to strobe a carriage movement, for instance, while a print is taking place.

Before a function can be strobed, however, the associated 'ready' line must be checked. There are four ready lines; three for each of the main functions (platen, carriage, printwheel), and the fourth shows if any of the other three are not ready. As soon as a ready line is down, the function can be strobed even if another function is already taking place. The strobe must be at least two microseconds long which is ideal for a micro system since that is about the shortest pulse it is possible to get out of an output port. The data must be present on the data lines before the strobe is applied and held until after the strobe is removed. There are three strobes, one for each function.

In addition to the data lines, the strobe lines and the ready lines, there are lines for selecting the printer and selecting the ready lines. There is also a line for paper out condition (this requires some kind of paper out switch to be effective) and a check line. The check line is used as a fault indicator to show that some false condition has been activated. The only signal which will be accepted by the printer after a check signal is the 'restore' command.

The restore command is used to reinitiate the printer mechanism after some kind of fault. The most common fault the beginner will encounter is a crash of the carriage into the end stops. I have brought the fault line out to a pushbutton on the front of the printer. When power is first applied to the printer, the electronics automatically initiate a restore sequence. A restore sequence moves the carriage to the extreme left edge and then back about  $\frac{1}{2}$  inch to the right of the left end stop and then sets the printwheel in an initialized condition so that the electronics know where the print wheel is. Sensing of the printwheel 'park' position is done by a special magnetic pickup and a small metal slug on the position transducer.

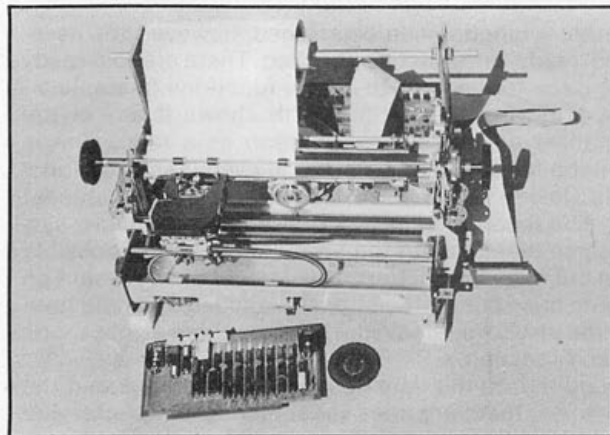
There are two position transducers: one on the back of the carriage servo motor and one on the back of the

printwheel servo motor. These are closely coupled high frequency sensors. Adjustment of the position transducers calls for specialized knowledge and equipment.

One final input is the 'ribbon lift'. In the original version of the HYTYPE I this was intended for use with two-color ribbons. However, the way the ribbon is mounted in front of the printwheel, it is impossible to see the most recently typed data. In my system I use the ribbon lift command to position the ribbon in front of the type wheel just before a print is to occur. After a spell of typing, there is a pause before the ribbon drops down to reveal the text. This pause, which is controlled by a re-triggerable monostable, prevents the ribbon from continually popping up and down in a most annoying manner. There is nothing unique about this scheme, and it is used in several other common terminals and in some of the recent HYTYPE II terminals. Of course, for this to be effective you will only be able to use one-color ribbons.

To summarize the data requirements of the HYTYPE I: there are 11 or 12 data lines, three strobes and a ribbon lift going to the printer from the computer, and four ready lines going from the printer to the computer. Thus, dedicated to the needs of the printer are two full output ports and one half of an input port. The other lines are not necessary for computer control and therefore don't require data ports. If your system has parallel ports already available, you don't need a special interface card and can skip the next section for the time being.

A photograph of the printer is shown in Photo 1. Note the home-built paper roll holder. The ribbon comes in a cassette form, and different colors as well as carbon ribbons are available. A spare daisywheel can be seen in front of the printer beside the interface board.



**PHOTO 1** Photograph of the HYTYPE I showing the Interface Board and a spare Daisywheel in front. Note the addition to the rack for holding rolls of paper. The flat cable for interconnection to the driver electronics is shown at the right.

## HARDWARE INTERFACE

As I said before, if you have a couple of good drive capability output ports available, you can skip the hardware discussion altogether. I chose to build an interface card for a number of reasons, the chief one of which was that I didn't have any parallel ports to spare. Besides, with the use of a wire wrap tool, some sockets and a Vector S-100 board, it's kind of relaxing and a change from the daily drag to immerse oneself in mundane wiring problems. Another reason for using the interface board was that I wanted to incorporate a small separate dedicated RAM area for later use as buffer storage. As it turned out, I don't use this buffer as such but it has sure come in handy for storing small programs such as memory test routines when I want to preserve my main memory completely free.

A final reason for using the dedicated interface was that I wanted to use a code conversion PROM between the data input and the printer. This allowed me complete freedom in the use of keyboard and input data and the printwheel characters.

A summary of the input data required to drive the printer was given in Table I along with a summary of the printer output data. All of the printer input data lines have 250 ohm pullup resistors, so you must provide driver devices with good current capability. Open collector or tri-state devices are equally effective.

The complete circuit diagrams for the interface cards are shown in Figures 1 and 2. The card is functionally divided into five areas. These are:

1. Address and Port decoding logic
2. RAM and associated buffers
3. Printer driver hardware and computer output ports
4. Computer input ports and data multiplexing circuitry
5. The ribbon lift circuit

The port selection logic and the RAM address decoding logic share some common parts, and both may be relocated together by means of the DIP switch to any 4K boundary. Location addresses and switch positions are given in Table II. In my system the RAM resides at A000, and consequently, the printer output ports A0 and A1. Note the port assignments on the circuit diagram.

Since my system is getting pretty full, I am now putting buffers on all S-100 bus card inputs. The address input buffers are 74LS367 operated in the non-tristate mode. The buffers on address inputs A9 and A8 are also used to drive the lower data bits of the port address decoding. The RAM devices are 2102, and chip select is

**Table II. Eight Position DIP Switch Coding**  
**a. Address Selection: ("0" = "on")**

Switch Number	RAM Starting Address	I/O Port Numbers
4 3 2 1		
0 0 0 0	0000	00,01
0 0 0 1	1000	10,11
0 0 1 0	2000	20,21
0 0 1 1	3000	30,31
0 1 0 0	4000	40,41
0 1 0 1	5000	50,51
0 1 1 0	6000	60,61
0 1 1 1	7000	70,71
1 0 0 0	8000	80,81
1 0 0 1	9000	90,91
1 0 1 0	A000	A0,A1
1 0 1 1	B000	B0,B1
1 1 0 0	C000	C0,C1
1 1 0 1	D000	D0,D1
1 1 1 0	E000	E0,E1
1 1 1 1	F000	F0,F1

**b. Hammer Intensity Selection:**

Switch Number	Relative Pressure Intensity
6 5	
0 0	1
0 1	2
1 0	3
1 1	4

**c. Spacing Selection:**

Switch Number	Character Spacing Characters/Inch	Line Spacing Lines/Inch
8 7		
0 0	10	3
0 1	10	6
1 0	12	3
1 1	12	6

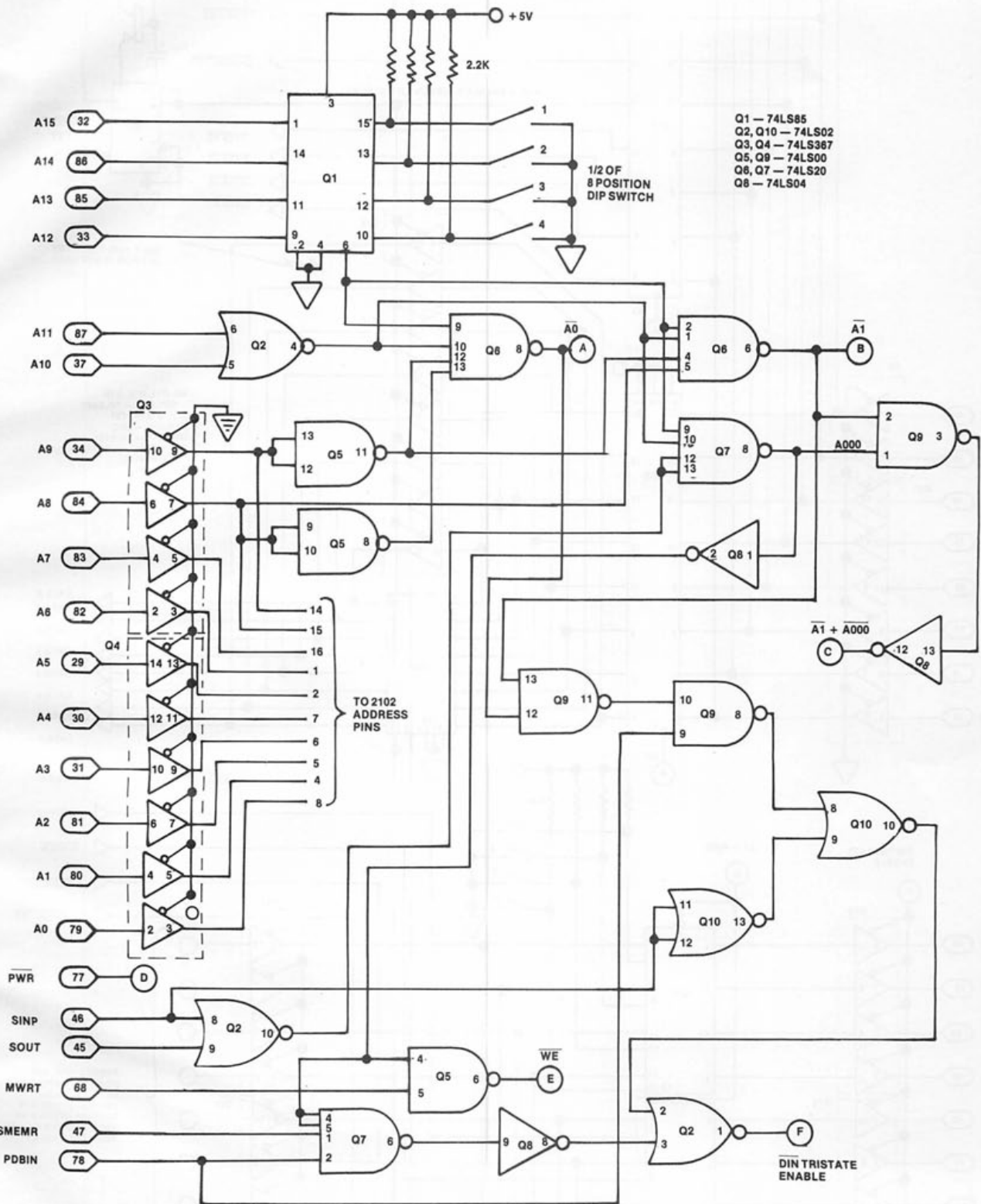
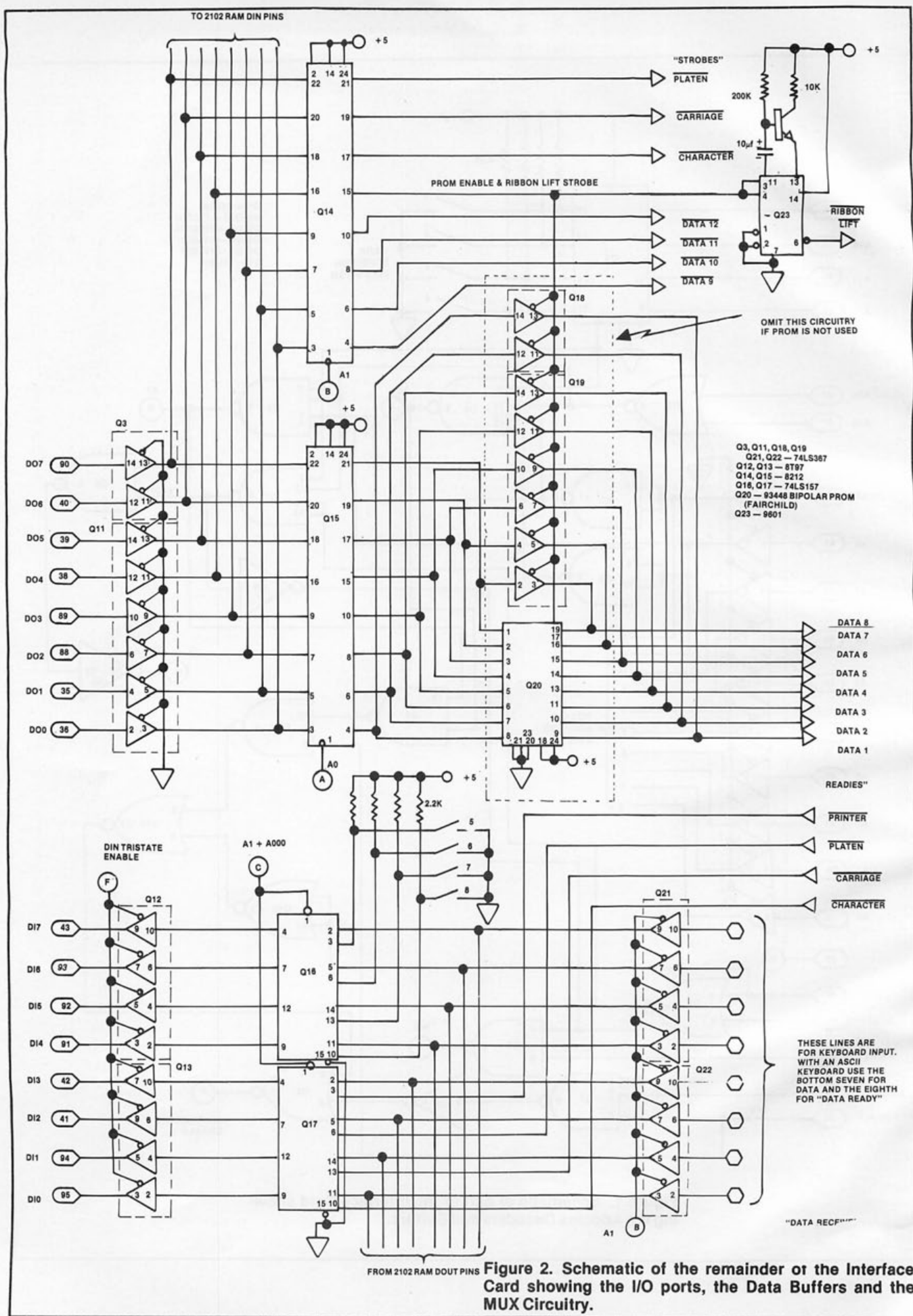
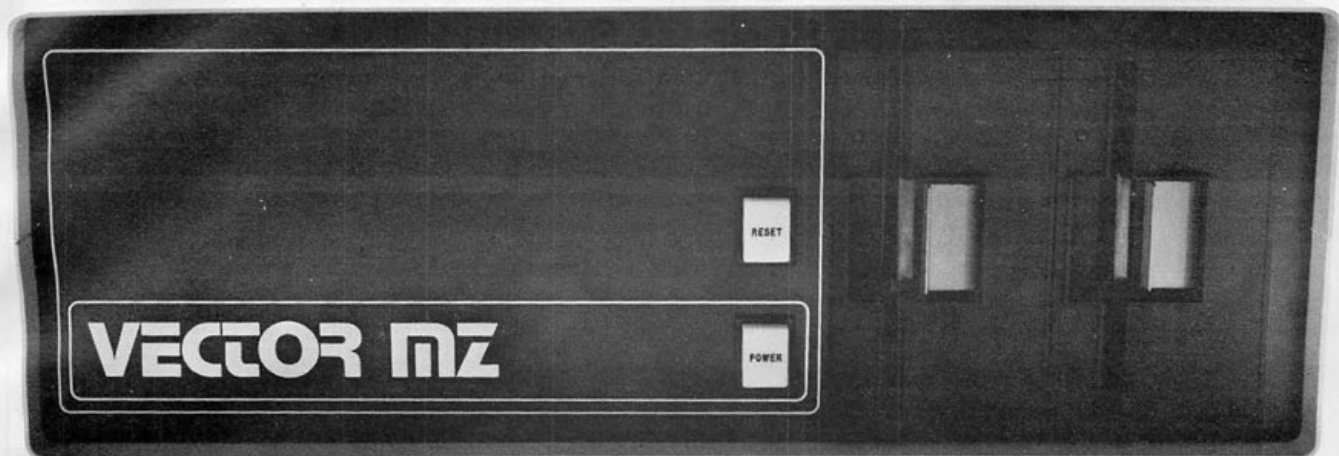


Figure 1. Schematic of part of the Interface Card showing the Address Decoders and Buffers.



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derived from the high order address bits and the processor SINP and SOUT lines. The RAM output data is multiplexed into the computer input data bus, as will be described later.

The necessary 16 bits of output required to drive the printer is generated through two 8212 output port devices. These have sufficient capability to drive the 250 ohm pullup resistors if necessary. In my system I have a code conversion PROM in the lower eight bits of the 12 bit data bus. This PROM is enabled by the ribbon lift signal and held on during the printing of a character. For all other outputs to the data bus, the PROM is bypassed by the 74LS367 tri-state buffers, and the lower eight bits appear on the data bus exactly as sent. If you don't want to do any code conversion, this bit of circuitry can be eliminated, or you can do any necessary conversion in the software. Incidentally, this conversion scheme is very handy for converting what-have-you to ASCII and vice versa. The 93448 PROM has room for two complete sets of code.

The computer input must be serviced from three sources on the card. These are the RAM output, the keyboard output and the status byte.

The keyboard output is combined with the RAM output on the same data lines by means of their respective tri-state outputs. This common data bus is one set of inputs to the 74LS157 multiplexers. The other set of inputs comes from two sources. The upper four bits come from the remaining four switches on the 8-bit address decoding DIP switch. These four switches are used, to set the character spacing, the line spacing and the character impression intensity, as will be described later. The lower four bits are provided by the four "ready" lines from the printer. These can thus be interrogated by the software. Selection of the computer data sources to be put on the S-100 bus is determined by the address decoding logic.

The final block on the circuit card is the ribbon lift circuit. This circuit uses a retriggerable one shot multivibrator, the 9601, to provide a pulse which holds the ribbon up between the print wheel and the platen for a fixed period of time. Each time a character is typed, the ribbon hold period is reinitiated so that during rapid typing of extended passages, the ribbon never drops. The emitter follower is used for time extension with the RC combination shown. If you think the ribbon lift time is unsatisfactory, this can be changed by changing the value of C. I experimented with several times and found those shown to be best for me.

All the circuitry shown in the figure is contained easily on one Vector S-100 circuit card. I used two regulators, one for the RAM and the PROM and the other for the remainder of the circuitry. Since all of the IC's shown are five volt devices, only two 7805 regulators are required.

A photograph of the completed board is given in Photo 2. Note the space at the top of the board for an additional 1K of RAM and the space in the lower left corner for additional keyboard or I/O circuitry. A socket is also provided for a keyboard PROM, if required.

## THE SOFTWARE

Now that you have the mechanical aspects of driving the HYTYPE I well in hand, the next step is the software. A complete listing of the software which I now use is given at the end of the article. This listing is for the simplest driver reasonably possible for the printer. If you want to do fancy things like changing the spacing dynamically, a more complicated program is necessary. I found that for the things which I do at the moment, the extra complications of the expanded software were not warranted.

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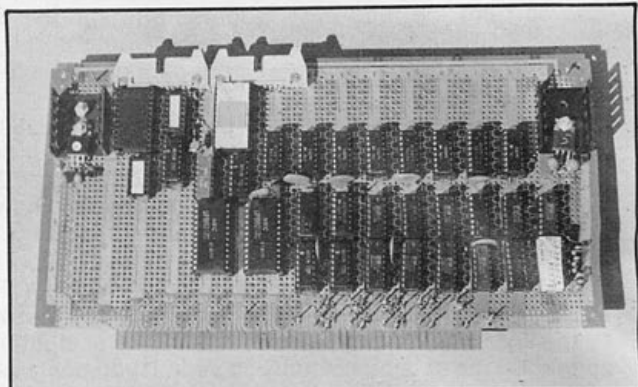
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**PHOTO 2** Photograph of the complete Interface Board. Two ribbon connectors are used to connect the board to an adapter plug which fits the ribbon cable from the printer. The keyboard would also enter here, if used.

The flow chart which describes the philosophy of the program is given in Figure 3. On entering the driver with something to be done, the first thing the program does is save all of the system registers, initialize the strobes and finally look at the setup switches to determine what character and line spacings are to be used. The switch status is saved in register B for later use. All input to the printer driver is assumed to be ASCII, so the parity bit is stripped before proceeding.

The program is arranged so that the most common functions are tried first. Obviously the largest usage of the printer is for typing characters, so the program first looks for a printable ASCII character. How a character is printed is described later on. If a printable character is not found, the program next looks to see if the input was one of the functions: SPACE, BACKSPACE, CARRIAGE RETURN, CRLF, LINEFEED, REVERSE LINEFEED, or SET LEFT MARGIN. If none of these are found, the default is a simple return without any action. Before returning from the driver, the last thing to be done is to recover all of the registers which were saved on entry. For this simple program, the functions are embedded in the program rather than contained in a lookup table. Thus, the program jumps from routine to routine looking for a match.

As an illustration of how the printer is strobed, we will use the routine PRNAS which prints an ASCII character. This routine is flowcharted in Figure 4. In the 12 bit printer the hammer impression can be controlled by the software. In my implementation there is a limited capability to do this as controlled by the DIP switch whose position was stored in register B on entry. Bits B4 and B5 control the impression density, but these should be bits D11 and D12 of the printer data bus, and this would mean that they should be in bits B2 and B3 of the data going to port A1. This gets all sorted out by shifting the data twice to the right and then masking it with OCH to eliminate the extraneous material.

With the impression bits set, we have hardly started. The next action is to set the strobes for all the outputs to "off" before sending the data to port A1 (remember this port does the strobing as well as set the upper four data lines). Thus our busy data byte now gets FOH added in. The upper 3 bits set the strobes to "off" while the next bit is used to trigger the ribbon lift and also, in my system, to turn on the PROM tri-state outputs (and turn off the PROM bypass drivers). The data byte to port A1 now looks like 1111 SS00 where 'S' indicates switch impression control data. Now the data (ASCII) byte can be put on the data lines by sending it through port A0. All of the setup is now complete, and the actual print can finally be performed.

The strobing of any function takes place in two steps. First, the function ready line is sampled to determine if

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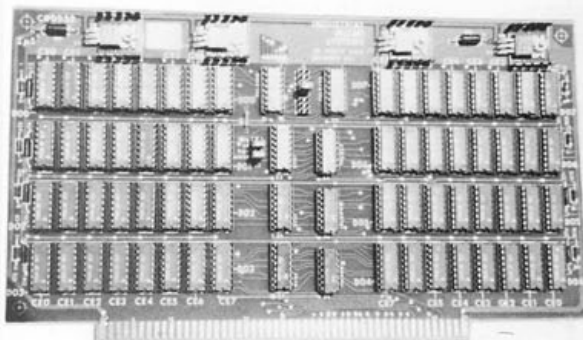
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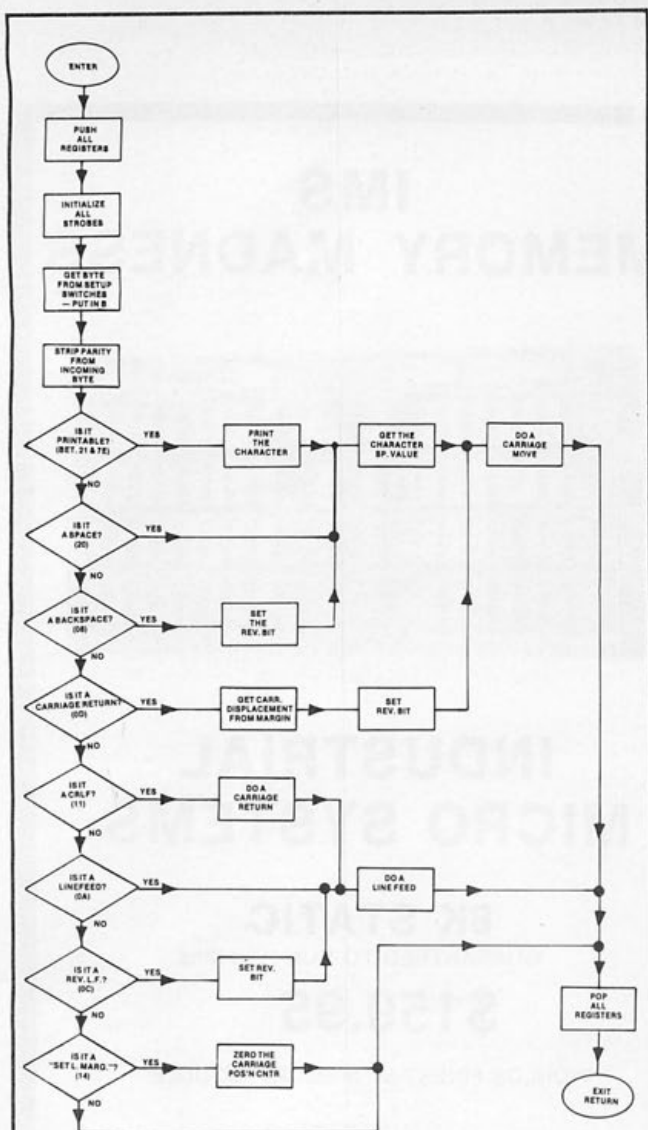


Figure 3. Flowchart for the overall Driver Software.

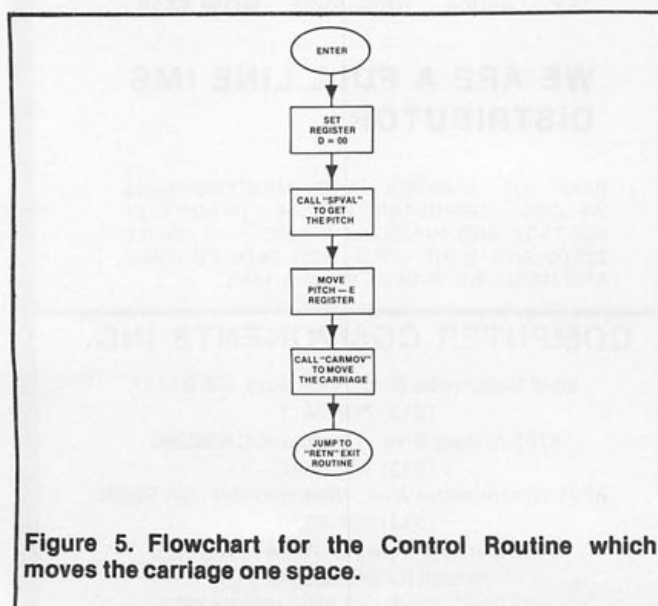


Figure 5. Flowchart for the Control Routine which moves the carriage one space.

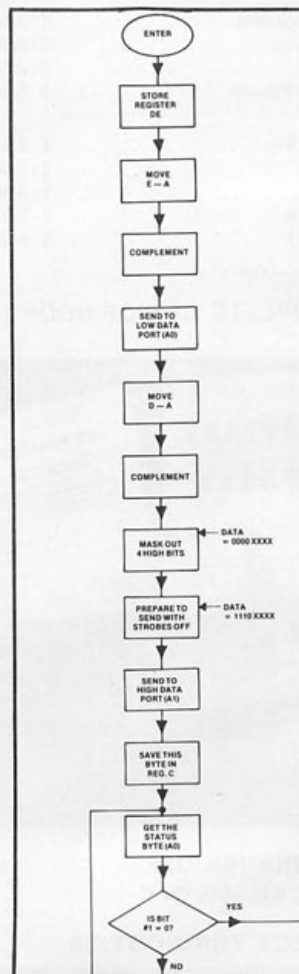
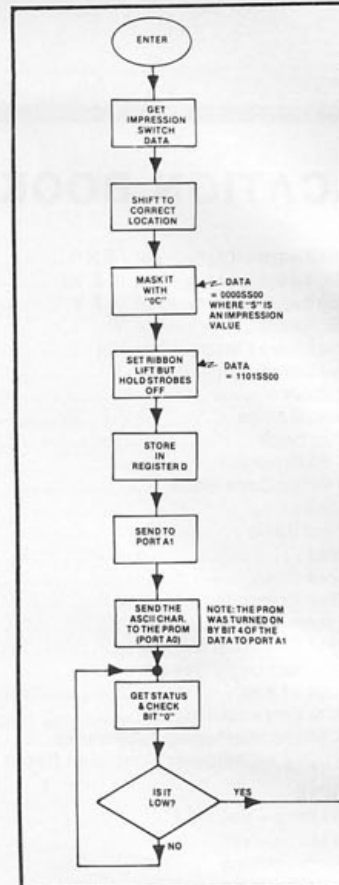


Figure 6. Flowchart for CARMOV — the Routine

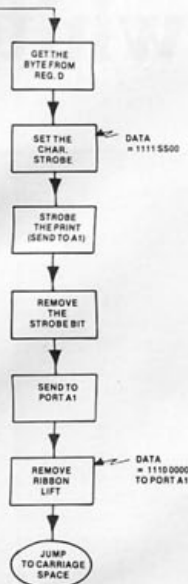
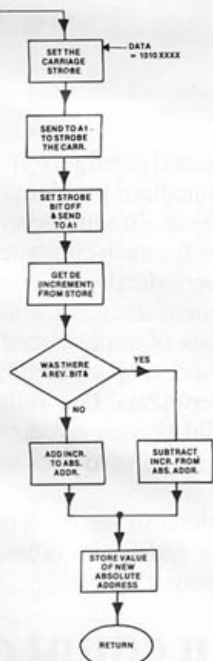


Figure 4. Flowchart for PRNAS — the Routine for Printing an ASCII Character.



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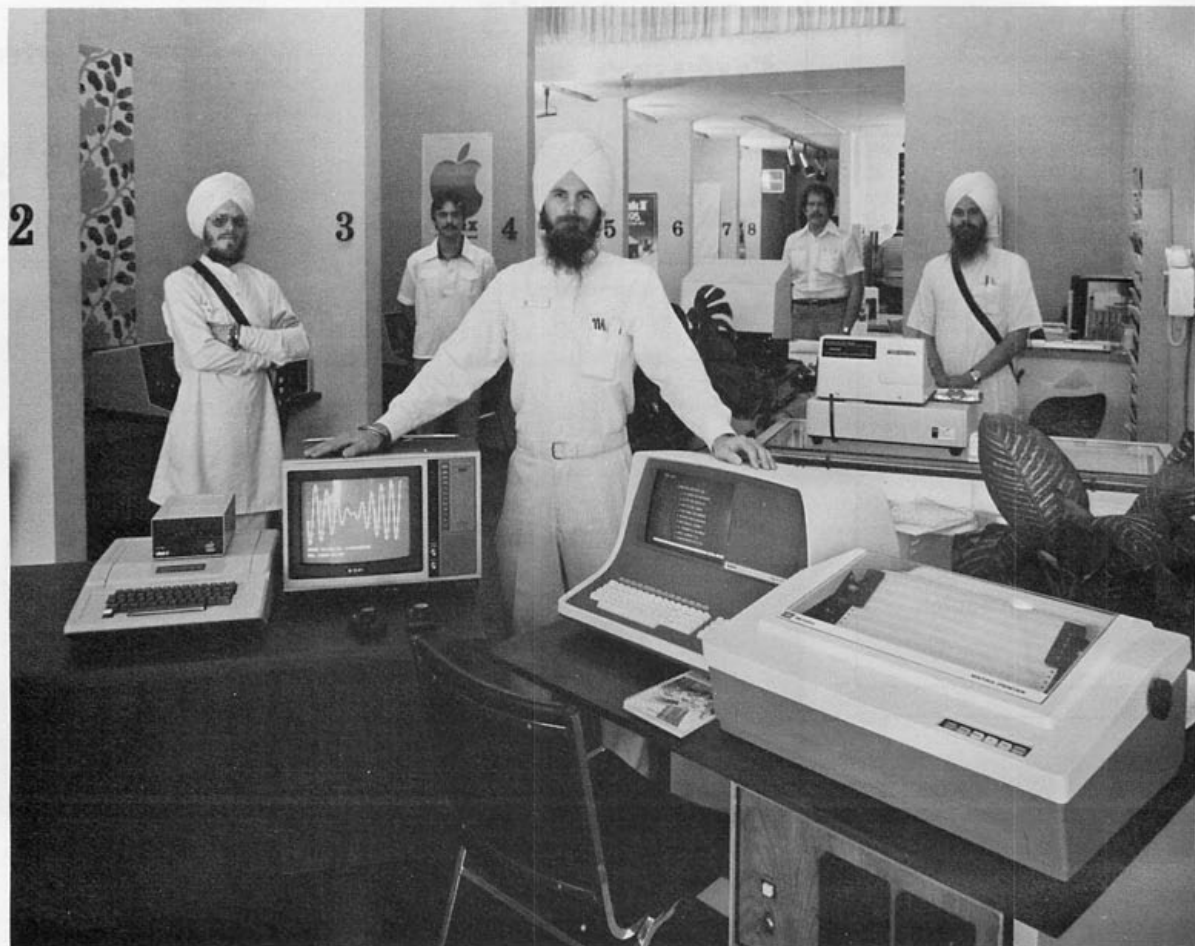
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the function is busy. When the ready line goes low, the function can be strobed. Referring to the hardware drawings, we see that the ready line for a character print is bit 0 from port A0. This is checked in a loop until it goes low, and then the strobe data byte is recovered from register D where it had been previously saved. The strobe is set by 'ANDing' with DE(HEX) so that the data now looks like 1101 SS00. This is sent to port A1 to do the actual strobe. Of course, the strobe pulse must now be removed, and this is done by replacing the missing bit by ORing with 20(HEX) and sending the byte to port A1 once again. Finally, the ribbon lift pulse is removed and the program jumps to the next step in which the carriage is advanced one space.

The routine which moves the carriage one space is called SPC1, (see Figure 5), and it contains two other routines which really do all of the work; SPCVAL determines the correct increment to move the carriage based on the switch input data, and CARMOV is a general program for moving the carriage an amount determined by the contents of register DE. As a final example of how the printer is controlled, we will now examine CARMOV.

Moving the carriage in the routine CARMOV involves the operation of putting the data on the lines and strobing, as is done with the print operation, and also keeping track of the absolute position of the carriage. Remember, in the mechanical description we noted that carriage movement is purely incremental and that extraneous means must be provided to keep track of the carriage position.

On enter CARMOV (Figure 6) the routine first stores the contents of register DE. This register has the increment data for the carriage movement. First the lower byte is complemented and sent directly to the printer via port A0, then the operations of masking and setting up the strobe bits are performed on the high byte. Here, the lower nibble contains carriage movement information (lower 3 bits in the case of the 11 bit machines). This is masked and the strobes-off information is added by ORing with E0. The byte is then sent to port A1 and temporarily saved in register C. The status byte is obtained from port A0 and examined in the loop until bit 1 becomes low. At this time the carriage strobe is inserted by ANDing with AF and the byte again sent to A1. The strobe is then removed as before.

Since the reverse direction is set by a bit in the highest data position and not by the type of number, it is necessary to check the highest data bit to see if the carriage movement data should be added or subtracted to the data contained in the absolute position register. After testing, the appropriate arithmetic function is performed and the new position data stored before the routine returns back to the main program.

There is one final piece of software which is needed for smooth operation of your printer. This is necessary because on turning on your system, it is possible for the strobe outputs to come up in any arrangement and for random data to be present in the carriage position storage location. In my system I have an initialization procedure which the system goes through when coming up from a cold start. I have added to this a small routine for setting up the printer parameters. A listing of this routine is shown in Program 1.

## PROGRAM 1

```
.RADIX 16
.TITLE 'Monitor Initialization Routine'
;This routine is inserted in the Monitor
;initialization subroutine for the purpose
;of correctly initializing the data ports
;feeding the DIABLO HYTYPE I printer
;mechanism
DINIT: MVI A,0E0 ;DATA FOR SETTING
        OUT OA1 ; STROBES TO OFF
        LXI H,0000 ;ZERO THE CARRIAGE
        SHLD OA3FC ; POSITION STORE
        .END
```

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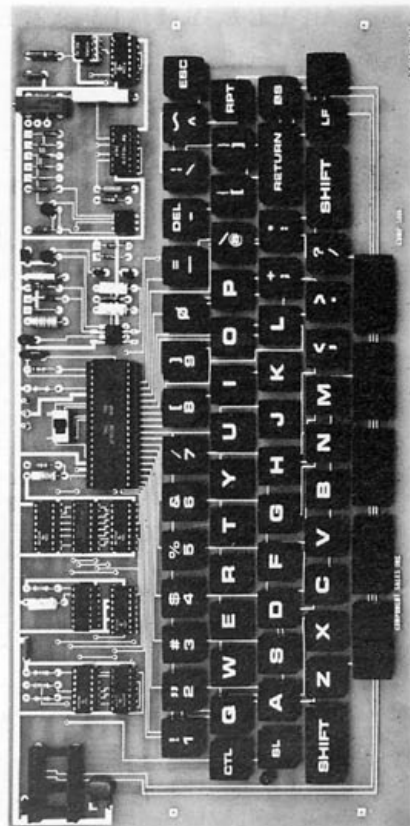
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Sometimes, because of a blown program, it is necessary to restart the system. This would normally be done without turning the printer off, and since the restart routine zeros the carriage absolute position count, you could be left with a printer sitting half way across the page and the system thinking this was the left margin. The way out of this is to use the "restore" line. On my printer I bring this out to a push button on the front of the printer. This works well for me. However, you might like to have the restore button on the keyboard as I had in an earlier configuration.

Now you're on your own. I certainly hope that you will gain as much use from your printer as I have from mine. It's a super mechanism and deserves much more recognition from the hobbyist than it is presently getting. □

Table III. Special Printer "Control" Functions

Control Character	HEX Code	Function
h	08	Backspace
t	14	Reset the left margin
q	11	CR + LF
l	0C	Reverse linefeed

Note: These special functions are recognized by the printer driver software — not by the printer itself. It is the driver software which tells the printer how to perform these functions.

## PROGRAM 2

```
.TITLE 'DAISYWHEEL PRINTER CONTROL ROUTINE'
.RADIX 16
;This program is written for Z-80 driven control
;of a Diablo HYTYPE I (TM) printer mechanism which
;has a 12 bit data input bus.
;The program uses a temporary storage RAM
;located between A3F0 and A3FF. The program is
;also configured for use with an interface PRGM for
;the print data. The data ports used are--
;Input A0=setup sense switches and printer readies
;A1=reserved for keyboard input (not used)
;Output A0=Printer and platen low data byte
;A1=Printer and platen low data byte
;
DIABLO: PUSH PSW ;SAVE THE REGISTERS
        PUSH B
        PUSH D
        PUSH H
        MOV A,OE0 ;INITIALIZE THE STROBES
        OUT OA1
        IN OA0 ;CHECK THE SETUP SWITCHES
        MOV B,A ;AND SAVE IN 'B'
;
;The input data byte is in register C.
;It is assumed ASCII
;
        MOV A,C
        ANI 7F ;STRIP PARITY
        MOV C,A
CHAR: CPI 21 ;PRINT EET 21H AND 7EH
        JRC SPACE
        CPI 7F
        JRZ SPACE
;
;The subroutine for printing an ASCII character
;
PRNAS: MOV A,B ;GET THE SWITCH DATA
        RRC ;SHIFT TO
        RRC ;CORRECT POSITION
        ANI 0C ;MASK IT
        ORI OF0 ;RIBBON LIFT & PROM ENABLE
        OUT OA1 ;STROBES STILL OFF
        MOV D,A ;HOLD THE PRESS. DATA
        MOV A,C
        OUT OA0 ;ASCII BYTE TO PROM
        IN OA0 ;CHECK STATUS
        BIT 0,A ;OF THE PRINT WHEEL
        JRNZ PRN1
        MOV A,D ;STROBE THE
        ANI 0DE
        OUT OA1 ;PRINT WHEEL ON
        ORI 20 ;AND OFF
        OUT OA1
        MVI A,OE0 ;REMOVE THE RIBBON LIFT
        OUT OA1
```

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Part no. 2

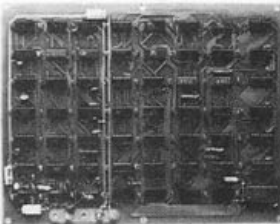
Baud rate is continuously adjustable from 0 to 30,000 • Plugs into any peripheral connector • Low current drain. RS-232 input and output • On board switch selectable 5 to 8 data bits, 1 or 2 stop bits, and parity or no parity either odd or even • Jumper selectable address • SOFTWARE • Input and Output routine from monitor or BASIC to teletype or other serial printer. • Program for using an Apple II for a video or an intelligent terminal. Also can output in correspondence code to interface with some selectrics. Board only — \$15.00; with parts — \$42.00; assembled and tested — \$62.00.



## T.V. TYPEWRITER

Part no. 106

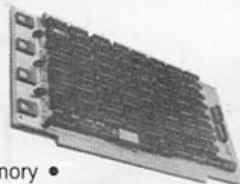
• Stand alone TVT • 32 char/line, 16 lines, modifications for 64 char/line included • Parallel ASCII (TTL) input • Video output • 1K on board memory • Output for computer controlled cursor • Auto scroll • Non-destructive cursor • Cursor inputs: up, down, left, right, home, EOL, EOS • Scroll up, down • Requires +5 volts at 1.5 amps, and -12 volts at 30 mA • All 7400, TTL chips • Char. gen. 2513 • Upper case only • Board only \$39.00; with parts \$145.00



## 8K STATIC RAM

Part no. 300

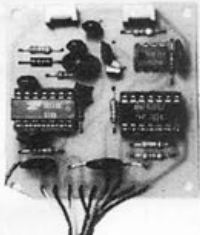
• 8K Altair bus memory • Uses 2102 Static memory chips • Memory protect • Gold contacts • Wait states • On board regulator • S-100 bus compatible • Vector input option • TRI state buffered • Board only \$22.50; with parts \$160.00



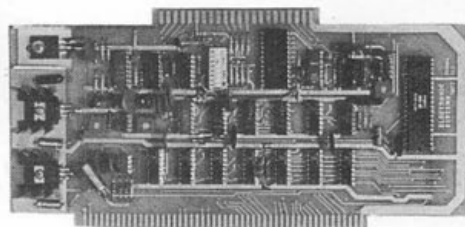
## MODEM \*

Part no. 109

• Type 103 • Full or half duplex • Works up to 300 baud • Originate or Answer • No coils, only low cost components • TTL input and output-serial • Connect 8 ohm speaker and crystal mic. directly to board • Uses XR FSK demodulator • Requires +5 volts • Board \$7.60; with parts \$27.50



## TIDMA \*



Part no. 112

• Tape Interface Direct Memory Access • Record and play programs without bootstrap loader (no prom) has FSK encoder/decoder for direct connections to low cost recorder at 1200 baud rate, and direct connections for inputs and outputs to a digital recorder at any baud rate. • S-100 bus compatible • Board only \$35.00; with parts \$110.00

## DC POWER SUPPLY \*

Part no. 6085

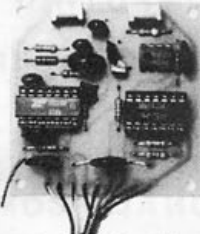
• Board supplies a regulated +5 volts at 3 amps., +12, -12, and -5 volts at 1 amp. • Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps. • Board only \$12.50; with parts excluding transformers \$42.50



## TAPE INTERFACE \*

Part no. 111

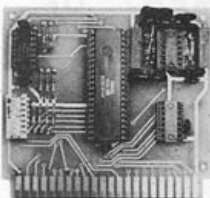
• Play and record Kansas City Standard tapes • Converts a low cost tape recorder to a digital recorder • Works up to 1200 baud • Digital in and out are TTL-serial • Output of board connects to mic. in of recorder • Earphone of recorder connects to input on board • No coils • Requires +5 volts, low power drain • Board \$7.60; with parts \$27.50



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Part no. 101

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## RF MODULATOR \*

Part no. 107

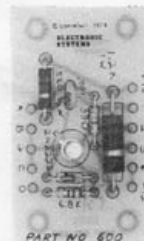
• Converts video to AM modulated RF, Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommended by Apple. • Power required is 12 volts AC C.T., or +5 volts DC • Board \$7.60; with parts \$13.50



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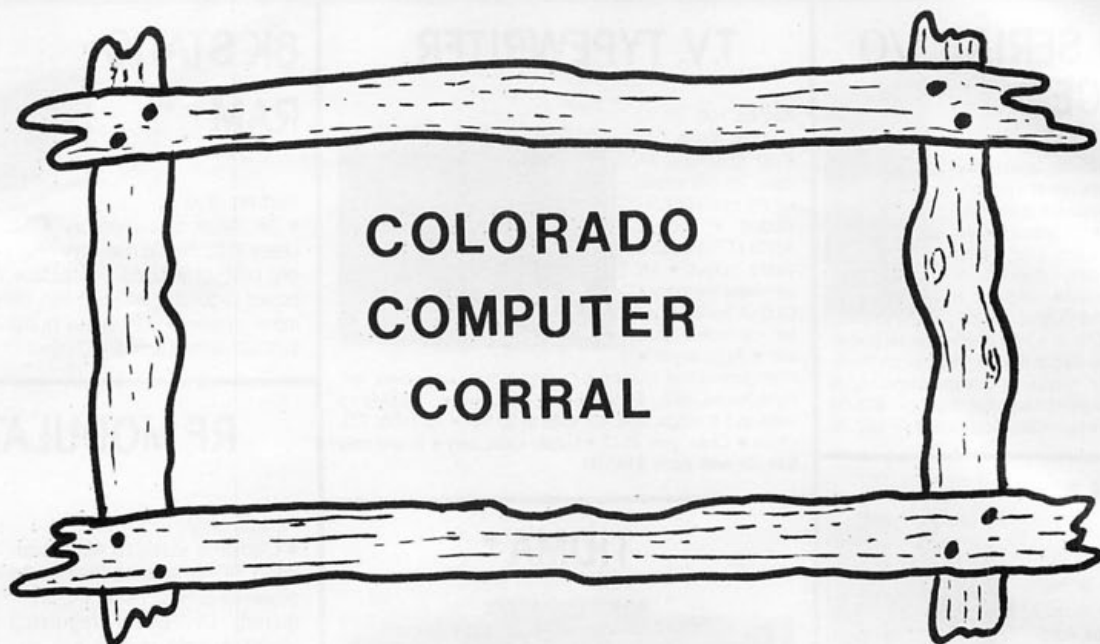
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```

0037' 1804      JMPR   SPC1      ;TO ADVANCE THE CARRIAGE
;
;These routines perform the various carriage
;space backspace and return functions. CRLF is
;a single command for both the CR and LF thus
;providing a potential program savings in external
;programs and for local operations.
;
0039' FE20      SPACE: CPI      20      ;SPACE?
003B' 200C      JRNZ     BKSP      ;
003D' 1600      SPC1:  MVI      D,00      ;
003F' CD 009B'  SPVAL: CALL    CARSP    ;GET THE PITCH
0042' 5F        MOV      E,A          ;
0043' CD 0089'   CALL    CARMV    ;DO 11
0046' C3 0095'   JMP      RETN      ;DONE
0049' FE08      BKSP:  CPI      08      ;BACKSPACE?
004B' 2004      JRNZ     CR          ;
004D' 1608      MVI      D,08      ;SET REVERSE BIT
004F' 18E8      JMPR   SPVAL      ;
0051' FE0D      CR:    CPI      0D      ;CR?
0053' 2012      JRNZ     CRLF      ;
0055' C6 005B'   CALL    CARTN     ;DO A RETURN
0058' C3 0095'   JMP      RETN      ;
005B' 2A A3FC   CARTN: LhLD    OA3FC    ;GET THE CARR. POSITION
005E' 7C        MOV      A,H          ;
005F' F608      ORI      08          ;SET THE REVERSE BIT
0061' 57        MOV      D,A          ;
0062' 5D        MOV      E,L          ;
0063' CD 00B9'   CALL    CARMV    ;
0066' C9        RET                  ;
0067' FE11      CRLF:  CPI      11      ;LINEFEED
0069' 2005      JRNZ     LF          ;
006B' CD 005B'   CALL    CARTN     ;DO THE RETURN
006E' 1804      JMPR   LINEF      ;
;
;The next routines perform the linefeed functions.
;Note that the Diablo has a reverse LF and that
;the platen does not need to move a line at a time.
;
0070' FE0A      LF:    CPI      0A      ;LINEFEED?
0072' 2009      JRNZ     RLINF      ;
0074' CD 00A8'   LINEF: CALL    LINSF    ;GET THE SPACING
0077' CD 00F2'   LINF1: CALL    PLTMV   ;MOV THE PLATEN
007A' C3 0095'   JMP      RETN      ;
007D' FE0C      RLINF: CPI      0C      ;REVERSE LINEFEED?
007F' 2009      JRNZ     RSETL      ;
0081' CD 00A8'   CALL    LINSF      ;
0084' 7A        MOV      A,D          ;
0085' F608      ORI      08          ;SET THE REVERSE BIT
0087' 57        MOV      D,A          ;

```

```

0088' 16ED      JMPR   LINF1      ;
;
;Utility to reset the left margin with control-t
;
008A' FE14      RSETL: CPI      14      ;RESET LEFT MARGIN?
008C' 2007      JRNZ     RETN      ;ERROR TRAP HOME
008E' AF        XRA      A          ;
008F' 57        MOV      D,A          ;
0090' 5F        MOV      E,A          ;
0091' ED53 A3FC SDED    OA3FC    ;STORE CARR POSN
;
;Final return to program
;
0095' E1        RETN:  POP      H          ;RESTORE STATUS
0096' D1        POP      D          ;
0097' C1        POP      B          ;
0098' F1        POP      PSW        ;
0099' 79        MOV      A,C          ;
009A' C9        RET                  ;
;
;Routine to select the carriage spacing from the
;DIP switch position.
;
009B' 78      CARSP:  MOV      A,B          ;
009C' E680      ANI      80          ;
009E' FE80      CPI      80          ;
00A0' 2003      JRNZ     TENCI      ;
00A2' 3E0A      MVI      A,0A        ;12 CHARS PER INCH
00A4' C9        RET                  ;
00A5' 3E0C      TENCI: MVI      A,0C    ;10 CHARS PER INCH
00A7' C9        RET                  ;
;
;Routine to select the platen spacing from the
;DIP switch position.
;
00A8' AF      LINSF:  XRA      A          ;
00A9' 57        MOV      D,A          ;
00AA' 78        MOV      A,B          ;
00AB' E640      ANI      40          ;
00AD' FE40      CPI      40          ;
00AF' 2004      JRNZ     LINS2      ;
00B1' 3E08      MVI      A,08        ;SET SINGLE SPACE
00B3' 5F        MOV      E,A          ;
00B4' C9        RET                  ;
00B5' 3E10      LINS2: MVI      A,10    ;SET DOUBLE SPACE
00B7' 5F        MOV      E,A          ;
00B8' C9        RET                  ;
;
;Routine for setting the 12 bits of carriage
;information on the data lines checking the ready
;and strobing the carriage to move.
;

```

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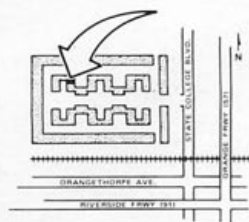
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CIRCLE INQUIRY NO. 69

```
00B9' ED53 A3F0  CARRV:  SDED  OA3F0  ;STORE THE POSITION STATUS
00BD' 7B          MOV    A,E          ;
00EE' 2F          CMA          ;INVERT THE DATA
00EF' D3A0        OUT    OA0          ;
00C1' 7A          MOV    A,D          ;
00C2' 2F          CMA          ;
00C3' E60F        ANI    OF          ;LOW NIBBLE ONLY
00C5' F6E0        ORI    OEO         ;STROBES OFF
00C7' D3A1        OUT    OA1         ;HIGH BYTE TO DIABLO
00C9' 4F          MOV    C,A         ;SAVE IT
00CA' DBA0        CARRY: IN    OA0   ;IS THE CARRIAGE READY?
00CC' CB4F        BIT    1,A         ;
00CE' 20FA        JRNZ  CARRY       ;
00D0' 79          MOV    A,C         ;GET THE HIGH BYTE
00D1' E6AF        ANI    OAF         ;SET THE STROBE
00D3' D3A1        OUT    OA1         ;AND DO IT
00D5' F640        ORI    40         ;STROBE
00D7' D3A1        OUT    OA1         ; OFF
```

;This routine adds the carriage movement increment  
(or subtracts it) to (from) the absolute carriage  
address on completion of a carriage movement

```
00D9' ED5B A3F0        LDED  OA3F0  ;GET THE MOVEMENT INCREMENT
00DD' CB5A            BIT    3,D      ;TEST FOR REVERSE
00DF' 2006            JRNZ  SUBTR     ;
00E1' 2A A3FC         LHL    OA3FC   ;
00E4' 19             DAD    D         ;
00E5' 1807            JMPR  STORE     ;
00E7' E607            SUBTR: ANI    07 ;MASK THE REV BIT
00E9' 2A A3FC         LHL    OA3FC   ;
00EC' ED52            DSHC  D         ;
00EE' 22 A3FC        STORE: SHLD  OA3FC ;STORE THE CARR. ADDR.
00F1' C9             RET              ;
```

;here the platen movement is set and strobed.  
;for this simple driver no record is kept  
;of the platen absolute address.

```
00F2' 7B          PLTMV: MOV    A,E  ;SET THE
00F3' 2F          CMA          ;
00F4' D3A0        OUT    OA0        ; LOW BYTE
00F6' 7A          MOV    A,D        ;MASK AND COMPLEMENT
00F7' 2F          CMA          ; THE HIGH BYTE
00F8' E60F        ANI    OF         ;
00FA' F6E0        ORI    OEO        ;RESET THE STROBES
00FC' D3A1        OUT    OA1        ; AND SEND THE HIGH BYTE
00FE' 4F          MOV    C,A        ;SAVE DURING THE CHECK
00FF' DBA0        PLRDY: IN    OA0  ;GET STATUS
0101' CB57        BIT    2,A        ;CHECK IT
0103' 20FA        JRNZ  PLRDY      ;
```

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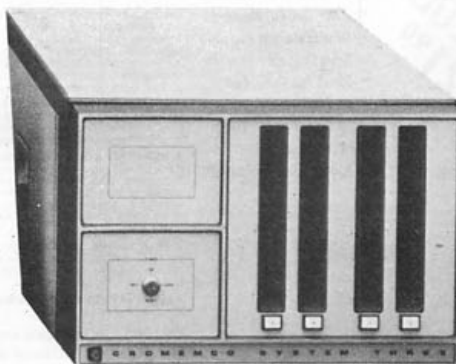
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INTERFACE AGE 117



```

0105' 79      MOV    A,C      ;GET THE BYTE
0106' 666F    ANI     6F      ;SET THE STROBE
0108' D3A1    OUT     0A1     ;AND DO IT
010A' F680    ORI     80      ; AND TURN IT OFF
010C' D3A1    OUT     0A1     ;
010E' C9      RET           ;
                .END

```

## SAMPLE TABLE

BKSP 0049'	CARDY 00CA'	CARMV 00B9'	CARSP 009B'
CARTN 005B'	CHAR 000F'	CH 0051'	CHLF 0067'
DIABLO 0000'	LF 0070'	LINEF 0074'	LINF1 0077'
LINS2 0065'	LINSF 00AD'	PLRDY 00FF'	PLTMV 00F2'
PRN1 0024'	PRNAS 0017'	RETN 0095'	RLINF 007D'
ASET1 006A'	SPACE 0039'	SPC1 003D'	SPVAL 003F'
STORE 00EE'	SUBTR 00E7'	TENCI 00A5'	

Hex listing of the diablo driver for location FA00

>dFA00 FB0E

```

FA00 F5 C5 D5 E5 3E E0 D3 A1 DB A0 47 79 E6 7F 4F FE
FA10 21 38 26 FE 7F 28 22 78 OF E6 0C F6 F0 D3 A1
FA20 57 79 D3 A0 DB A0 CB 47 20 FA 7A E6 DE D3 A1 F6
FA30 20 D3 A1 3E E0 D3 A1 18 04 FE 20 20 0C 16 00 CD
FA40 9B FA 5F CD B9 FA C3 95 FA FE 08 20 04 16 06 18
FA50 EE FE 0D 20 12 CD 5B FA C3 95 FA 2A FC A3 7C F6
FA60 06 57 5D CD B9 FA C9 FE 11 20 05 CD 5B FA 18 04
FA70 FE 0A 20 09 CD A8 FA CD F2 FA C3 95 FA FE 0C 20
FA80 09 CD A8 FA 7A F6 06 57 18 ED FE 14 20 07 AF 57
FA90 5F ED 53 FC A3 E1 D1 C1 F1 79 C9 78 E6 80 FE 80
FAA0 20 03 3E 0A C9 3E 0C C9 AF 57 78 E6 40 FE 40 20
FAB0 04 3E 08 5F C9 3E 10 5F C9 ED 53 F0 A3 7B 2F D3
FAC0 A0 7A 2F E6 0F F6 E0 D3 A1 4F DB A0 CB 4F 20 FA
FAD0 79 E6 AF D3 A1 F6 40 D3 A1 ED 56 F0 A3 C5 5A 20
FAE0 06 2A FC A3 19 16 07 E6 07 2A FC A3 ED 52 22 FC
FAF0 A3 C9 7B 2F D3 A0 7A 2F E6 0F F6 E0 D3 A1 4F DB
FB00 A0 C5 57 20 FA 79 E6 6F D3 A1 F6 80 D3 A1 C9
>AC=C

```

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CIRCLE INQUIRY NO. 78

# NEW PRODUCTS

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For more information, price sheets and samples contact Echo Design & Development Corp., 195 E. Gish Rd., San Jose, CA 95112, (408) 292-0918.

Readers who mailed an inquiry card on this new product from the February 1978 issue are asked to resubmit, as all inquiries for this company were forwarded to the wrong address.

CIRCLE INQUIRY NO. 128

## CCSA-Type Switching System

The Release 5, a low-cost option of the ROLM® CBX Business Telephone System software, will enable small and medium size companies to install private CCSA-type switching systems.



ROM's network uses the standard 7-digit numbering plan for inter-office calls and 10-digits for off-net calls; it can be retrofitted into existing CNX installations.

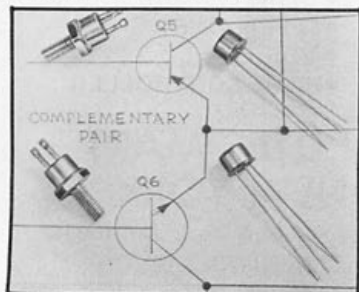
The ROLM CCSA System can also be used for regular long distance traffic. The phone user simply dials "9" plus the number desired, including area code. ROLM CX Route Optimization takes it from there. Call queuing can be used for making off or on-net calls.

For more information contact ROLM Corporation, 4900 Old Ironside Dr., Santa Clara, CA 95050, (408) 988-2900.

CIRCLE INQUIRY NO. 111

## Complementary Transistors Give High Performance

Eight new PNP and NPN transistors with 80V collector-emitter voltages, 5A continuous collector currents and operating frequencies to 70MHz, provide high-performance in power amplifier and switching circuits.



The 2N5003, 2N5005, 2N5151 and 2N5153 PNP transistors have 100V collector-base voltages, 2A continuous base currents and emitter-base voltages of 5.5V. The NPN devices, 2N5002, 2N5004, 2N5152 and 2N5154, have similar electrical ratings permitting their use in complementary-pair circuits.

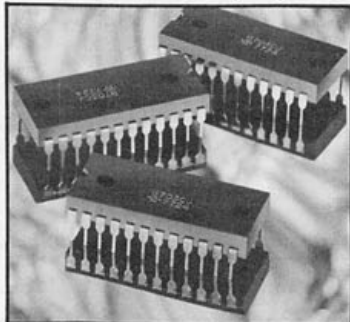
In 100-999 quantities, prices are: 2N5002, \$13.00 each; 2N5003, \$15.00 each; 2N5004, \$18.00 each; 2N5005, \$25.00 each; 2N5151, \$7.00 each; 2N5152, \$4.25 each; 2N5153, \$8.00 each and 2N5154, \$5.00 each.

For more information contact Solid State Devices, Inc., 14830 Valley View Ave., La Mirada, CA 90638, (213) 921-9660.

CIRCLE INQUIRY NO. 112

## Three-State A/D Converter

Teledyne Semiconductor has expanded its line of monolithic data conversion products with the addition of 8, 10, and 12 bit A/D converters with three state binary output.



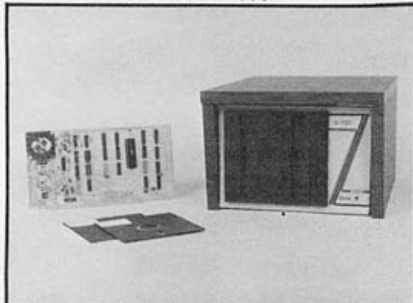
The device utilizes low power CMOS technology and is fully self contained in a single 24-pin DIP requiring only passive support components. Its integrating principle of operation gives it inherently high accuracy, linearity and noise immunity. Conversion speed is 1 to 20 ms.

The device is available in plastic or ceramic packages. 100 quantity prices for the 8-bit unit in plastic, \$8.95; 10-bit plastic, \$11.50 and 12-bit ceramic, \$25.00. Delivery is stock to four weeks. For more information contact Teledyne Semiconductor, 15840 Ventura Blvd., Encino, CA 91436, (213) 986-8506.

CIRCLE INQUIRY NO. 113

## Quay 80 F1

The Quay 80 F1 is a floppy disk system for use in S-100 bus computers. The Quay 80 F1 system includes the Q/80 FDC (floppy disk controller) board capable of supporting up to four disks, QDOS disk based operating system, the Q/FD1 125 KB  $5\frac{1}{4}$ " band-driven disk drive with power regulator and interface cable, and the Q/80 FC floppy disk cabinet.



In addition to the floppy disk support, the Q/FDC has available a programmable 8-bit, TTL compatible, parallel I/O port capable of supporting standard peripheral devices such as line printers, tape punches, keyboards, etc.

Price for the Quay 80 F1 system is \$795. Add-on drives (Q/FD1) are \$395 each. Delivery is 30-60 days ARO. For more information contact Quay Corporation, P.O. Box 386, Freehold, NJ 07228, (201) 681-8700.

CIRCLE INQUIRY NO. 114

## Selector Switch

The Model 8544-D, A, B, C, D, CRT Selector Switch allows the user to switch any 2-wire input to any one of four 2-wire outputs. All connections are made at the rear panel.



In application, the Model 8544-D (Desktop) module allows the user to manually select any one of four CRT displays. The unit is ideally suited for switching the IBM 3270 interface or any 2-wire telephone line.

A four-position rotary switch on the front panel instantly switches any 2-wire input from a rear panel BNC labeled Common to any one of four BNC's labeled A to D. This module is available for desktop switching only, and no power is required.

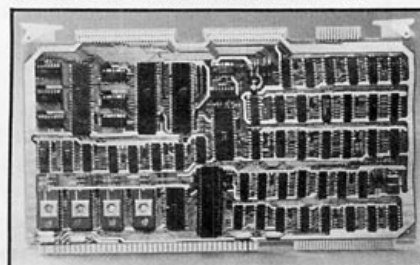
The Model 8544-D is priced at \$160. Delivery is 30 days ARO. For more information contact Marketing Dept., International Data Sciences, Inc., 100 Nashua St., Providence, RI 02904, (401) 274-5100.

CIRCLE INQUIRY NO. 124

## Intelligent Floppy Disk Controller

The IFC-8400 controller will control up to eight SA400 or SA800 Shugart single-sided, single density flexible disk drives.

The IFC-8400 will permit interface to any computer or stand-alone terminal over an RS-232C or 20 mA current loop serial channel or optional parallel 8-bit TTL I/O channels.



The IFC-8400 also includes a 1K byte RAM buffer to hold data being transferred between host and diskette. Use of a buffer RAM larger than a single sector size allows for certain commands to be implemented more efficiently than with a smaller buffer. This decreases command execution times by decreasing unnecessary head movements.

The new IFC-8400 is priced at \$795 and is available immediately. For more information and quantity pricing contact Cybernetic Micro Systems, 2378A Walsh Ave., Santa Clara, CA 95050, (408) 249-9255.

CIRCLE INQUIRY NO. 125

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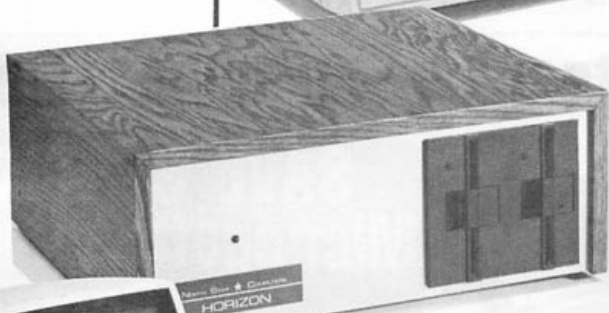
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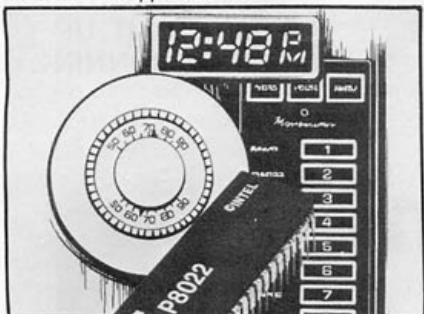
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## Single Chip Microcomputer Has On-Board NMOS A/D Converter

The 8022 is a low cost, general purpose single-chip microcomputer containing a full analog-to-digital (A/D) converter. Aimed at high volume control applications, the microcomputer is ideal for applications such as home appliances, test and measurement instruments, automotive, process control, environmental control, sensing/recording instruments and other control applications.



The 8022 is software compatible with other single-chip microcomputers in the MCS-48 family of microcomputers and peripheral components. Another unique feature of the 8022 is its accurate on-chip oscillator, which can be externally synchronized with a crystal or a TTL-level clock signal.

For more information contact Intel Corp., 3065 Bowers Ave., Santa Clara, CA 95051, (408) 249-8027, Rob Walker.

CIRCLE INQUIRY NO. 117

## MOPS Software Packages Enhances Debugging Capabilities of COSMAC

A new software package, the Micromonitor Operating System (MOPS) CDP18S831, provides Micromonitor users with enhanced debugging techniques ranging from simple ter-

minial-Micromonitor dialog to hands-off system testing with commands coming from disk files.



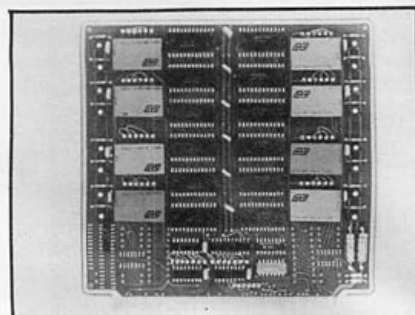
The MOPS CDP18S831 consists of a MOPS diskette plus a UART module, and connecting cable to interface the Micromonitor to the CDS. Literature support includes the *Micromonitor Operating System (MOPS) CDP18S831 Users' Guide*, MPM-231, which describes the installation and startup of MOPS, the specific commands available to the user and command usage.

In single quantities, the RCA COSMAC Micromonitor Operating System is priced at \$350 and the Micromonitor at \$1600. For more information contact RCA Solid State Div., Box 3200, Somerville, NJ 08876, (201) 685-6380, MOS Product Marketing.

CIRCLE INQUIRY NO. 118

## Zilog Z80 Compatible DAC Card

Completely compatible with the Zilog Z80 microcomputer board this digital to analog converter card offers four or eight channels of conversion, each channel having 12 bit resolution; less than 0.5 bit nonlinearity; individual zero and full-scale adjustments; five user selectable output voltage levels; optional 4-20 ma current output; memory mapped address selection; and double buffering.

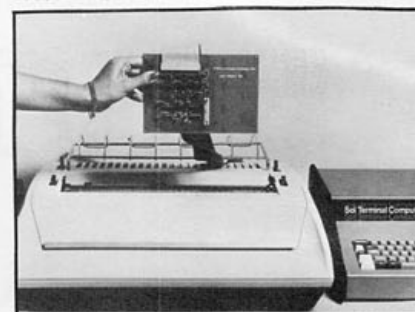


The Model 608 DAC card price is \$595 for 4 channels and \$895 for 8 channels, in small quantities. For more information contact Signal Laboratories, Inc., 202 N. State College Blvd., Orange, CA 92668, (714) 634-1533, Del Flagg.

CIRCLE INQUIRY NO. 126

## Two New Printer Interfaces

Sol Hytype I mounts inside any Diablo Series 1200 Printer connecting it directly to the back of the Sol. Similarly the Sol Hytype II Printer Interface works with the Diablo Series 1300 Printer.



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cuit board, software, all cables and mounting hardware. No modification to the Sol is necessary. No holes need be drilled in the printer. The printer can be restored to its original condition if required.

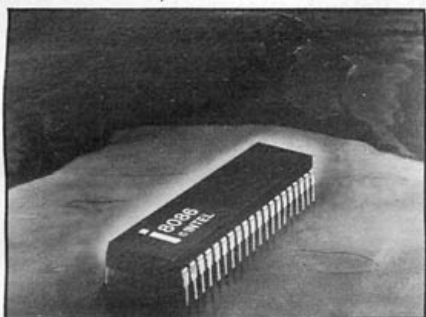
Hytype driver software is included on CUTS cassette along with a source listing. The user may modify the driver software to suite a particular application.

Suggested retail price for both the Hytype I and Hytype II is \$150. Delivery is stock to 30 days. For more information see your Sol dealer ad contact Processor Technology Corp., 7100 Johnson Industrial Dr., Pleasanton, CA 94566, (415) 829-2600.

CIRCLE INQUIRY NO. 119

### 16-Bit Microprocessor Family

The MCS-86™ Microprocessor Family is comprised of the 16-bit 8086 CPU and its peripheral support components, development software, and design development aids. Designed to deliver ten times the performance of the 8080, the 8086 provides features never before found on a microprocessor.



Some of these features are extended addressing capability — up to one million bytes; 16-bit hardware multiply/divide; elaborate string handling instructions; dynamic memory relocation; reentrant program code, position-independent programs; instruction look ahead.

These features, while providing a new architecture, at the same time maintain compatibility with the 8080 and 8085 microprocessor families. For more information contact Intel Corp., 3065 Bowers Ave., Santa Clara, CA 95051, (408) 249-8027, Rob Walker.

CIRCLE INQUIRY NO. 130

### MCZ-1 Microcomputer Implements New Integrated Terminal

The MCZ-1/60 consists of an intelligent terminal with 4K bytes of RAM expandable to 52K bytes, a general purpose computer with 32K bytes of RAM expandable to 64K bytes, and an integral 9-inch CRT — all in a single desk-top unit. Dual rack-mounted floppy disk drives provide 600K bytes of on-line program and data storage.

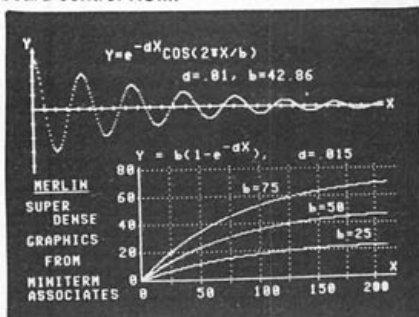


Incorporating Zilog's own Z80-CPU microprocessor and 16K dynamic RAM chips, the MCZ-1/60 sells for \$6,990 in single quantities with delivery in 60 days. The system is also available in a version with desk-top disk drives, designated MCZ-1/62. For more information contact Zilog, 10340 Bubb Rd., Cupertino, CA 95014, (408) 446-4666, Dave West.

CIRCLE INQUIRY NO. 127

### Graphic/Text Video Interface

Merlin is a combination text and graphic video display board, combining functions of text display, graphic display (320H by 200V resolution), keyboard input port, and 4K bytes of on-board control ROM.



Merlin displays 20 lines of easily readable text with 40 characters per line. This is suitable for text editing, BASIC and assembly programs and large screen classroom use. Both upper and lower case characters can be displayed.

The Merlin video interface provides the main console I/O in a small system, or can be the heart of a sophisticated graphic development system.

Price for Merlin assembled and tested is under \$500. In kit form without ROM software price is less than \$300. For more information contact Miniterm Assoc., Inc., Dundee Park, Andover, MA 01810, (617) 470-0525, Dave King.

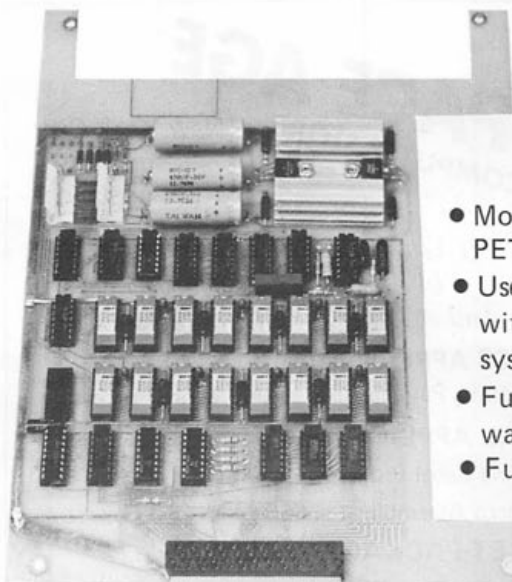
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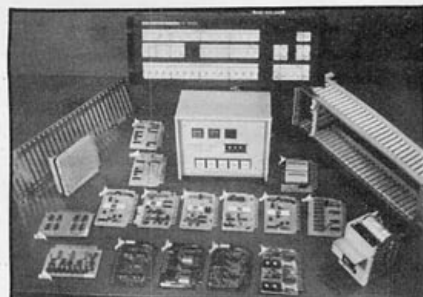
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CIRCLE INQUIRY NO. 80



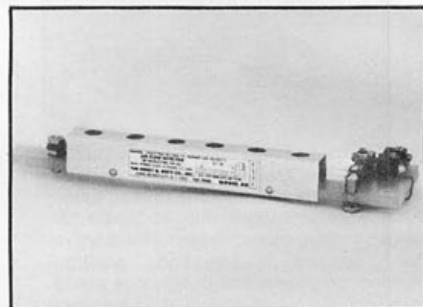
Additional modules include relays, test point modules, extender, lamp, toggle switch and a wide variety of socket, wire wrap and blank modules. Also available are card fields and card drawers for rack mount or custom installations, and logic power supplies.

For additional information contact Wyle Laboratories/Computer Products, 3200 Magruder Blvd., Hampton, VA 23666, (804) 838-0122.

CIRCLE INQUIRY NO. 129

## Air Velocity Detector Increases Reliability of Air Cooled Equipment

The Dietz Model AD Air Velocity Detector will indicate air flow in the range of 1 foot per second to an infinite air velocity. It can be used to detect the lack of air flow in air cooled electronic equipment, such as computers.



The Dietz Model AD Air Velocity Detector provides a sensitivity to air flow that increases as the air flow diminishes, is immune to shock, vibration, and ambient temperature changes, is low cost, and of small physical size.

The Model AD can be mounted across the face of the blower, requiring only an additional 1/2" of space. For additional details contact Henry G. Dietz Co., Inc., 14-26 28th Ave., Long Island City, NY 11102, (212) 726-3347, Henry Dietz, president.

CIRCLE INQUIRY NO. 122

## Literature on Subminiature Switches

C&K Components, Inc., is now offering its latests addition to its line of consumer-oriented literature. SFC 678 includes 16 pages of subminiature and microminiature toggles, rockers, pushbuttons and power switches from the extensive C&K switch line.



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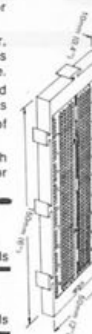
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14.0 7.2 4.0 1.1 5.7 2.2 15-B	15-G 15-L 8.80
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	3.200	5.0000	8.0000	18.000	
	3.2768	5.0688	18.4320		
	2.000	3.5795	5.1850	20.0000	@3.50
	2.0100	5.7143	22.1184		
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# INTRODUCTION

## to the

### TEX AND REAL APPLICATIONS

Now you'll see some examples from a system for physical mail (electronic mail is interconnected, but not shown here). Many readers will find it useful to study the programs for the algorithms, if not for TEX. Their challenge is to write the same programs in BASIC or any other language, for comparison with these TEX programs for the same procedures. I'll guarantee that TEX is much easier and shorter!

The mail system has these parts (individual programs):

- Creating the name/address file.
- Updating the name/address file.
- Adding or changing indication of membership on a specific mailing list.
- Displaying a mailing list, on a cover sheet or as labels.
- Archiving the various source lists; that is, making an integrated set of permanent copies.

The original database is the telephone directory. People working for a company often consider the accuracy of their entry in it to have priority second only to payroll. To understand the programs to be explained here, the database format needs to be known. It is a linear/sequential file of entries of this form:

```
surname, (given) # tel-no # org. # address # room # bldg
```

The entries are of variable length. "address" is a 4-character mail-station here, but it could be a full address just as easily. "#" is used to represent visibly the Horizontal Tab character. It gets replaced automatically in all display programs.

### LINE PRINTER DISPLAY OF THE TELEPHONE BOOK

First let's look at a program called "alphetel", which is the proofing run before photocomposition of the telephone book (directory).

```
!alphetel clear * restart=0                                a
!restart0 out:"alphetel" has restart capability."          b
filename="telbook,q" call texlib/old if fail call ouch c
out:*lf,"Have the file." rs:"#";*:*ht b out:"Tabs in." d
call texlib/datehead b ib:*cl:".pape 65"                  e
i:*cl:".repl ~" i:*cl:".tabu 27,37,55,61,69"               f
filename="sink" call texlib/resa restart=1                 g
out:"Restart1 passed. Now you can, in case of"            h
out:"any failure, restart at the last restart"            i
out:"passed by entering 'call alphetel!restart'."          j
goto !nostart1                                             k

!restart1 filename="sink" call texlib/old f:".tab"         l
!nostart1 i:*cl:"*hd" i:*cl:".space" i:*cl:".space"        m
call separate call widow                                  n
out:"Widowing operation complete",*lf                      o
b r:"*hd";*                                                p
                                Organization/ Mail          q
.break                                                     r
  Name   Phone   Component   Sta.   Room   Bldg.          s
.break                                                     t
.space                                                     u
*null                                                      v
b out:"Restart2 (paging) passed." call texlib/resa        w
restart=2 goto !nostart2                                   x
y

!restart2 filename="sink" call texlib/old                  z
!nostart2 call texlib/formsink which="a" name="sink"       aa
id="(my-ID)" bill="(my-charge)"                            bb
call texlib/print!howmany nosubs return                   cc

!restart subs $                                             dd
goto !restart$restart$                                      ee
```

Figure 1. The program "alphetel"

In Figure 1, the lines of "alphetel" to be explained are keyed to letters on the right:

- Programs that use a fair amount of computer time should have restart capability, so that not all of the work is lost in case of a failure. The user of this program is advised that it is restartable.
- At the terminal we would just say "old telbook" to get that file. If it was busy, or had a password we

## Part Three

# TEX Language

By Robert W. Bemer

did not provide, a message to that effect would be displayed. Manual correction action could be taken. In executive files such actions must be automatic. So we set the content of the variable "filename" to be the name of the wanted file, and call a program named "old". But this isn't one of our personal files. It belongs to another (but synthetic) user called "tex-lib". All of its programs constitute a library of service routines and general applications. "old" contains:

```
subs | if filename:eqs:*null goto !fail
ergo !fail old |filename|
fail='f' |*svmd| return
!fail fail='t' |*svmd| return
```

The error forms for "goto" and "call" verbs are "ergoto" (or "ergo") and "ercall" (or "erca"). They are obeyed only if anything following them (on the same line) fails. This permits "failsoft" operation and recovery from failures. In this case a failure to get the requested file sets the variable "fail" to "t", and returns.

A comma and the letter "q", for "query", follow the name of the wanted file. This gets us a snapshot copy of the file even if someone else is then changing it. If even this should somehow fail, "ouch" is called to repair the situation.

d In any lengthy process, it's sensible to advise the user (even yourself) how it is going. All "#" characters are replaced by Horizontal Tab:

```
"rs:" means replace the string
"," means do it the following number of times
"*" means all
"." means with the character following
```

When the process reaches end-of-file, "b" means back up to the beginning. After this is done, another advisory message.

e The library program "datehead" prefaces the current file with a message "This display requested by (your name) on (the date) at (the time)". It's always useful to do this, to distinguish among several versions or runs. "ib" stands for "insert

before" (the current line) a line that has the content enclosed in the delimiters.

f After that line (but still before the first current line), two more lines are inserted. One tells the formatting program to replace all characters "A" with incompressible spaces; the next gives the tab stop positions.

g Now the content of "filename" is changed to "sink", which is where we wish to keep the intermediate results of our process. The library program "resa" (for resave) puts the current file into "sink", and the variable "restart" is set to 1.

h Now we can tell the user that he can restart, and how to do it. Suppose something goes wrong just after this point. Per instructions the user would enter "call alphetel!restart".

dd The program would recommence execution at the label "restart", which sets the substitution (subs) mode with the \$ sign. We can't continue on this same line because all substitution in a line is done before any execution of the line begins. So the subs mode must always be set one line prior to its usage.

ee Now the value of "restart" gets substituted, and in this case we go to line "l".

k Line "l" is skipped, and control is at line "m".

l If we had to restart, the correct file position is located by finding the line starting with ".tab".

m Three lines are inserted. One is a dummy to stand for the eventual heading, and two cause spaces in the display program.

n "separate" separates the last name starting with "A" from the first starting with "B", etc., and puts the starting letters in the gaps. "widow" does the paging, ensuring at the same time that no new initial letter group starts unless there are at least three entries in that group before a new page begins.

o Another "we're still here and working" message.

p The dummy heading "hd" is replaced by the real one, which is specified in lines "p" through "v". The ".break" commands force new lines.

u This yields a continuous underline in photo-composition.

- w This simulates the extra Return to show that the replacement is complete.
- x Back to beginning of file, which is put into "sink" in the new and modified form.
- y The restart count is bumped up, and control goes to line "aa".
- aa "formsink" automatically formats the file and puts it in "sink". The ASCII line printer routine is set by "a", and the file to print is identified.
- bb "id" specifies *whose* file "sink", and "bill" is for timesharing charges.
- cc The only variable left unspecified is "howmany", so the "print" program is called at that entry point. After that starts, the subs mode is turned off, and the program ends.

## MAKING THE ORIGINAL MAIL CONTROL FILE

The goal is to create a new file (called "telmail") by extracting the name and address from each line entry. Only programs (not people) access this file for modification, so the "#" character is unnecessary. The file entry format is:

```
name HT address\1.16.5.23.38.14.
```

This means that this individual's name occurs on special mailing lists 1, 16, 5, 23, 38, and 14. The periods delimit the list numbers uniquely. But this is after "telmail" has been processed many times. The original format is:

```
name HT address\.
```

Figure 2 is the program that builds "telmail" originally.

```
!makemail out:*lf,"Starting 'makemail' at ",*time,*lf a
clear * call !setup ht=ht call !fixup b

!nameit ib:*cl:("This file created ",*date) |official| c
!nameit again |suffix| d
filename=sinkname |make_new_else| goto !nameit_again e
|exit1| f
out:"""",sinkname,"" contain name and address" |exit2| g

!fixup filename="telbook,q" |get_it| h
out:"Have the file" d:"""",* b i
!lineLoop ro:"#";3:*rs scan:*cl:*rs j
r:*cl:(*'>"",ht,*r">"",*") f;1 |eof| k
goto !lineLoop l

!setup cant=\b out:"Can't find ", name goto !match\ m
bump=\count=count+1 name="n",count\ t=\in:"List number\ n
what no=t,\is? " tag=*in if (*in>*n):ne:*lin goto\ o
official=out:"For the official 'telmail', just CR" \ p
t=\in:"Else what suffix? " sinkname=*userid,"/telmail" \ q
suffix=t,\,*in if *lin:eq:0 sinkname="the/telmail" \ r
exit2=\nocase nosubs out:*lf,"Done at ",*time return\ s
exit1=\if fail out:*lf,"No action is taken." \,exit2 t
if yes=\if *in\j1:eqs:"Y" \ u
retry=\in:"Try another suffix? " \,if yes v
t=\if fail out:"A file ",sinkname," \ w
doesnt=t,\does not exist." \ does=t,\already exists." \ x
get_it=\call texlib/old \ make new=\call texlib/save \ y
get_it else=get_it,doesnt,retry z
make new else=make new,does,retry aa
null_cf=\call texlib/new \ put away=\call texlib/resa\ bb
eof=\if *eof b return\ case subs | return cc
```

Figure 2. The program "makemail"

In explanation of Figure 2:

- b The subprogram "setup" (lines "m" through "c") defines variables to have certain procedures as content. Used by most of the component programs in the mail system, they are explained as encountered. They compact the programs and make them easier to read and to understand. The variable "ht" is defined to be the Horizontal Tab character. The program is called at the label "fixup".
- h "telbook" is gotten as the current file, again on a snapshot basis. "get\_it" is a procedure. For a different computer we would redefine "get\_it" to be the corresponding procedure. Thus the kernel of the mail program is portable.
- i After a "working" message, all lines starting "AAA" are deleted. They are the redundant entries for secretaries listed following the people they work with. Back to beginning of file.
- j A loop operating on all remaining lines. "ro" means "replace occurrence". So the third occurrence of the "#" character is replaced by a Record Separator character. The current line is then scanned on that character.
- k Both left and right parts are kept only as far as the first "#" encountered, and adjoined by the content of "ht", which was a HT character. The two characters "\." are placed at string end, and the entire string replaces the original line. The pointer is moved to the following line. If an end-of-file signal is received, the process returns to line "c".
- l Else it's repeated until the entire file is converted.
- c For the record, an identifying line is inserted automatically at the beginning of file. Then the user is asked if it's the official telmail file he's making.
- d If he replies with just a CR to "Else what suffix?", it will be the official file. Else it will be a personal copy for private purposes. E.g., for a list of the rockhounds, or equestrians. That file name is the content of "sinkname".
- e The file this program will make should not exist yet. So an attempt to create it is made. If it fails, a message says that a file of that name already exists, and would you like to change your mind about the suffix?
- f If the user gives up, the creation attempt was still a failure, and the program closes by saying that no action was taken.
- g With success, we are so notified, and the process is wrapped up and complete.

## UPDATING THE MAIL CONTROL FILE

People leave, and new people come. Those still there get transferred or moved to new offices. And so the content of the telephone directory changes — particularly the address (mail station in this case). Periodic updates of two types are desirable:

- Frequent microfiche copies, or online interrogation, for the switchboard operator.
- Less frequent photocomposed and published copies for all employees.

The programs of this article were motivated in part by failures to get mailing lists changed or corrected by human procedures, often even after two years. And when I converted the old punch card system for the telephone directory, the process turned up six deceased, a woman who had left four years ago for motherhood, and a fictitious "Fred Fortran" in Manufacturing!

Figure 3 shows the program "update", which updates the file "telmail" for currency and correct address content, while preserving the existing mailing list membership data.

```

!update out:*lf,"Starting 'update' at ",*time,*lf      a
clear * call !setup [official]                        b
!update again [suffix]                                c
ht=*ht,*us call !fixup                                 d
filename=*;sinkname [get_it_else] goto !update_again  e
[exit1]                                                f
out:"Have both files" sort *;*(A25) (A1)              g
out:"These names are new, in case you"                h
out:" wish to add them to any list.",*lf f;1          i
call !just1 b rs:ht;*;ht filename=sinkname [put away] j
call !listold out:"",sinkname,"" updated" [exit2]      k

!just1 [eof]                                          l
scan:*cl:ht if *lm:eq:0 cut;1 goto !just1             m
!new nname=*l f;1 scan:*cl:ht                         n
if *lm:ne:0 out:nname goto !new                       o
if nname:eqs:*l scan:*r:"\." d b;1 a:*r f;1 goto !just1 p
cut;1 out:nname goto !just1                          q

!listold [null_cf] b paste b a;*;"|" b cuts:"\.";* b r
out:"These names are no longer valid."               s
out:" Rerun indicated lists to remove them.",*lf     t
p;* paste return                                     u

```

Figure 3. The program "update"

In explanation of Figure 3:

- b With line "c", the same procedures used in making the original telmail file.
- d Now the same creation process ("fixup") is applied, except that this time the variable "ht" has the extra Unit Separator in it.
- e The filename is defined to adjoin the new file just made with the old file. We wish to transfer the mailing list identifications from the old file to the new, scrapping the old entries. Again, existence is controlled by the procedures. If we wish to give up, that happens via the "exit1" procedure in line "f".
- g A "working" notice. The sort procedure is called. The Unit Separator, as a control character, collates low to any graphic. Thus when the same person appears in both new and old files, the new entry precedes when the two files are sorted together. The sort verb reads "Sort the current file (\*) into the current file (i.e., in situ); an alphabetic field of the first 25 characters is defined as the first sort key; sort ascending (A) on the first field".
- h With line "i", a signal that there may be names in the telephone directory now that weren't in there before.
- j The subprogram "just1" is called to ensure that double entries have the information transferred to the new entry, and to delete old entries without a corresponding new.
- l If end-of-file, return.
- m Scan for "ht", which still contains the Unit Separator. If the length of \*middle is zero, we didn't find it, so the line is an OLD entry. In that case we cut it from the file (it is added to a separate "cut" file, and thus deleted from the current file) and go back to try the next line for a new entry.
- n If we get here we have a NEW entry. "nname" is the new name. The next line is inspected to see if it is a matching OLD entry.
- o If "ht" is found it's a NEW, not OLD, entry. So the previous entry was a new listing in the phone book, and "nname" is printed out according to the

cover message of lines "h" and "i". Back to try again for a pair.

- p Now there is a NEW-OLD pair. Do they match? If so, the tag information is picked up from the OLD entry as \*r. The OLD entry is deleted; a backup of one line points to the NEW entry. "a:\*r" means put \*r after the text of the current line. That entry is now fixed, and we go to the next line to repeat the process.
- q If we get here, it's a peculiar coincidence that a new person and one no longer in the directory just happen to be adjacent in the ordering. The OLD one is cut, and the new one printed. Upon end-of-file we go back to finish line "j".
- j Back to beginning of file, which now contains only NEW entries. "ht" is replaced in each line by HT,

**TEX is. . . useful for prototyping applications that might eventually be done in compiler-type languages. It checks out design and human interfaces fast. Most debugging is done. . . on live data.**

and the file is resaved.

- k Having listed all new (added) names during the process, in case they should go on any mailing lists, we call the subprogram "listold", to print the names to be removed from the source mailing lists.
- r A null current file is made per line "cc" of Figure 2. The cut file is pasted to it. After every line we put a vertical bar character, and back to beginning. Now all lines containing the string "\." are cut, because if such a string is found the entry is not on any list, so why bother to tell anyone? And to the beginning again.
- s With line "t", tells the user what will be listed.
- u "p;" means "print all lines". The cut file is pasted just to clear it out for future processes. Return to line "k" and wrap-up of the process.

```

!chnglist out:*lf,"Changing list at ",*time,*lf goto !sk a
!newlist out:*lf,"Adding list at ",*time,*lf          b
!sk clear * call !setup                                c
!list no [what no] !list no                             d
filename="mail",tag [get_it] count=0 p;2 f;1           e
call !vector [official]                                 f
!suf [suffix]                                           g
filename=sinkname [get_it_else] goto !suf              h
[exit1]                                                  i
rs:(" ",tag,".");*;" " b count=0 call !match [put away] j
out:"",sinkname,"" updated by 'mail',tag,"" [exit2]    k

!vector if *eof [bump] _name=*cl'<" " f;1 goto !vector l
limit=count out:"mail",tag,"" names vectored." return m

!match if limit:eq:count return                          n
[bump] scan: _name:" " if *lm:eq:0 call !exception      o
last=*l,*m f:last if *eof b f:last if *eof [cant]      p
call !components M="A"                                  q
W1=W3 A1=A3 L1=L3 W2=W4 A2=A4 L2=L4 max=0 linect=0      r
!lastloop scan:*cl:" "                                  s
if (*l,*m):nes:last call !high goto !match             t

```

Figure 4. Branched to next page

Figure 4. Vectored from previous page

```

scan: *r: *ht split: *l: 0 call !components n=0          u
if L2: ne: 0 if L4: ne: 0 call !region1 goto !have_it    v
if L2: eq: 0 if L4: eq: 0 call !region4 goto !have_it    w
!region23 del=1 M="A" if L1: gt: 1 if L3: gt: 1 del=3 M="W" x
if |M|1: eqs: |M|3 n=del if n: eq: 3 goto !have_it      y
if L2: eq: 0 W2=W1 A2=A1 W3=W4 A3=A4                  z
del=1 if L2: gt: 1 if L3: gt: 1 del=3 M="W"            aa
if |M|2: eqs: |M|3 if del: gt: n n=del                 bb

!have_it n=n*1000+900-linect if n: gt: max max=n        cc
if ("000", max)'C3: eq: 6 call !high goto !match        dd
linect=linect+1 f; 1 goto !lastloop                     ee

!high t=(900-max[C3] if max: lt: 1000 b;t |cant| return  ff
b f: last f; t a:(tag, ".") b; t return                  gg

!region1 del=1 if L2: gt: 1 if L4: gt: 1 del=3 M="W"    hh
if |M|2: nes: |M|4 return                                ii
n=del M="A"                                              jj

!region4 del=1 if L1: gt: 1 if L3: gt: 1 del=3 M="W"    kk
if |M|1: nes: |M|3 n=0 return                          ll
n=n+del return                                          mm

!components scan: *r: " " split: *r: 1 A3=*l scan: *r: *uc nn
W3=(A3,*l)'<*a A4=*r'J1 W4=*r'<*a L3=W3>*sub L4=W4>*sub oo
if L3: gt: 1 scan: W3: " " if *lm: ne: 0 call !exception pp
if L4: gt: 1 scan: W4: " " if *lm: ne: 0 call !exception qq
return                                                  rr

```

Figure 4. The program "newlist"

## SETTING UP A NEW MAILING LIST

Figure 4 is the program "newlist", used to add indications for a new mailing list, and to update an existing but changed list. Refinements could be made for faster operation and more elegant decisions for search terminations. But that gets too large to show here!

In explanation of Figure 4:

- c With line "d", the standard procedure to begin.
- d "what\_no" (Figure 2, line "o"), permits no reply except digits. It does so by scanning the input for a character not a digit. If the count is less than total length, it's not all digits.
- e The designated mailing list is brought as the current file. The first two lines (identifying data) are printed. Then we move to the first name to find.
- f The subprogram "vector" puts each name of the mailing list into one variable of a vector, the names of which run from "n1" to "ni".
- l If not done, "bump" (Figure 2, line "n") ups the subscript count 1 and makes the content of "name" the current line with any righthand spaces removed. The process loops on this single line until end-of-file.
- m When the whole file is assigned, the last value of "count" is assigned to "limit", so the stepping process can be reconstructed. A message, and return.
- g With lines "h" and "i", a familiar process.
- j The old indicator for this mailing list (number and bracketing periods) is replaced by a single period everywhere it occurs. If it's a new list being added, none are found. The count is reinitialized to use the name vector in the matching process, and it is called.
- n If the count is at limit, the name vector is exhausted. Return to line "j", save the modified file, wrap-up.
- o The name string is broken on the comma, which is critical in two ways: 1) If there isn't any we have a problem, and must execute "exception" (not shown).

- p 2) The comma must be included in "last" for the search, else we might think that "Johns" was found when it was actually "Johnson".
- If not found, backup to file beginning, in case the file may be in wrong sequence. But if such a last name still isn't found, the "cant" procedure (Figure 2, line "m") is executed. It takes the program back to the label "match", for the next name.
- q "components" is called to obtain the first and middle names or initials. "M" is set to "A", which identifies the name of initials. Whole names use "W".
- nn \*right, including all but the last name, is scanned for not space. This handles 0 to n spaces after a comma. W3 and W4 the first and middle names. L3 and L4 will be their lengths in characters, and A3 and A4 the initials of those names.
- The first initial *must* be the first character. It could be followed by another capital, a period, a space, or small letters of the complete name (which could also have a period, like "Jas." and "Jno.").
- "A3" is the beginning capital of the first name. \*right is broken for *its* \*right to begin with a capital.
- oo The initial and residual up to the middle name are scanned from the right for the first letter, removing blanks or other punctuation between the given names. "A4" is the beginning capital of the middle name, and the middle name is found in the same way.
- pp If not an initial, the first name is checked. If it contains a space the exception subprogram is called. Line "qq" does the same for the middle name.
- rr Back to complete line "q".
- r "components" works on names in the address file, where the "3" and "4" subscripts are used. In this case it is serving a vectored name, and the subscripts are changed to "1" and "2". "linect", set to 0, is the count (from the first occurrence of the surname) where the best match is found.
- "max" is the highest "n" found for any set of given names. **RULE:** If both names are present, count 3 for a full name match, 1 for an initial match, for each name (maximum of 6 is possible). If one or the other middle name is missing, match the existing middle name against the other first name if the first match fails.
- s A loop to pick up the surname in the list "telmail".
- t If no match, the set of wanted surnames is exhausted. Do the subprogram "high" to pick the best fit so far. Then get the next vectored name.
- u The address is stripped, and the given names subjected to "components" after the value is initialized.
- v If both middle names/initials exist, "region1" is called to match them. It continues into "region4" to match first names/initials.
- w If only first names for both, "region4".
- x "del" is the scoring value. It's 1 except if both names are not initials, in which case it's 3, and we compare whole names (W) instead of initials (A).
- y The test is made. If pass, "n" is set to the value. If it is 3, the first names had a full match, and there is no use checking crosswise to a middle name. E.g., "Quitecontrary, Mary Mary".
- z We must match first against the existing middle. This line effects interchange for one of the two conditions, so that lines "aa" and "bb" work for both cases.
- aa The same value setting, initial or full name.
- bb If a match, and a higher value than we have so far, the higher is it. E.g., matching "A. Andrew" to "Andrew", the middle name is a better match.

cc We get here by falling through for regions 2 and 3, by a "goto" from regions 1 and 4. The value is put in the 4th position by multiplying by 1000; the line count is decremented from 900 (in this case the maximum of a single surname that can be tested. It is decremented so that the first individual with the highest value is the match. If "n" is higher than the old maximum, it becomes the new maximum.

dd 6 is the highest possible value. Stop looking.

ee Else up the line count, go forward to the next name to test, and repeat.

ff "t" is the line count for the maximum. But if we didn't get a value of at least 1, there is no match at all.

gg To beginning of file again. Find the surname once more, and move forward (count) lines. After that entry append the list number and another period. Back up to the first of that surname and retry.

### MAKING THE MAILING LIST TO USE

Figure 5 is a program "display", which makes a cover sheet, or labels, as the directing medium for a specific list.

```

!display out:*lf,"Starting 'display' at ",*time,*lf
clear * call !setup [official]
!display_again [suffix]
filename=sinkname [get_it_else] goto !display_again
[exit1]
!list2 [what_no] !list2
cuts:(" ",tag,".");* [null_cf]
b paste b d;1 a;:*rs b ds:"\","*rs;* b
in:"Want labels?" [if_yes] call !labels [exit2]
call !cover [exit2]

!cover in:"Want in mail station order?"
[if_yes] call !ms_order sort *;:(A4)(A1)
if *in:]1:nes:"Y" call !no_order
ib:*cl:("Mailing List No. ",tag) i:*cl:" "
b p="n" cols=2 n=50 see="n" call texlib/n-up!bf
filename="sink" [put_away]
out:"List is in your file 'sink' "
out:"You may use 'texlib/2print sink(n)', or"
in:"List at the terminal?" [if_yes] b p;*
return

!ms_order [eof]
scan:*cl:*ht pre=*l split:*r:1
r:*cl:(*l,(" ",*r)[3," ",pre) f;1 goto !ms_order

!no_order [eof]
scan:*cl:*ht r:*cl:(*l," ") ]25,*r
f;1 goto !no_order

```

Figure 5. The program "display"

In explanation of Figure 5:

a Through line "f", standard practices of the previous programs.

g All lines containing the indication for the wanted mailing list are cut from the current file. A null file is created.

h The cut lines are pasted, and the first line of the file (a dummy blank) is deleted. A Record Separator (\*rs) is put after each line. Then all strings between "\ " and RS are deleted. This destroys all of the list indicators, leaving only name and address.

i if labels are wanted, that program (not shown) is called, and the process ended.

j Else the subprogram "cover" is called.

k An option is given.

l If accepted, the subprogram "ms\_order" is called.

u At end-of-file, a return upon process completion.

v Else the line is broken on the HT character. The single letter prefix (in this particular scheme) is split off.

w The line is reconstructed and replaced. Now the address is in front, the numeric part of the address is right-justified, and the names are all left-justified. Go to the next line, and repeat until end-of-file.

m If the option wasn't accepted, the lines must still be conditioned.

y The lines are split. Blank spaces are inserted and truncated so that the addresses will be left-justified.

z To the next line, and repeat until done.

n The identification is put into the first line of the list, followed by a blank line.

o Four parameter values are present for the general-purpose program "n-up", so that it may be called at the label "bf" (for "brief"), and thus avoid interactive questioning. The value "n" for "see" means that we do not wish to see the process working. The name list is formed into two columns of 50 lines per page.

p The formatted list is put into "sink".

q We are told that.

r And how to print it with the line printer if desired.

s Else we have the option to print it at the terminal.

### ADVANTAGES OF TEX

The user gets many bonuses from using TEX, many of which are not always expected:

- Application programs are compact. Most fit on a single page, in one field of view. This aids the human mind in comprehension. No thumbing back and forth.
- That means they also consume less storage.
- And there is less to change when you want to modify a program.

Our Dick Petersen made a database entry program and showed it to the people that had to do the work every day. Each suggested redesign to their preferences, plus some needs Dick had not foreseen. He was back in an hour, with the program running their way (a service few users get from programmers that use other languages)! Naturally they were disposed to use it. And their productivity immediately more than doubled!

- Plan-ahead and structured programming, although surely desirable, are not so vital. With TEX, I usually find it easier to jump right in and build a part, thinking meanwhile about the whole. I can always change both programs and file formats with very little effort, if that appears necessary. In the jargon of the software engineers, one can move easily back and forth between "bottom-up" and "top-down" methods.
- Programs are easy to cannibalize for other, but related, purposes.
- TEX is also useful for prototyping applications that might eventually be done in compiler-type languages. It checks out design and human interfaces fast.
- Responses to data entry prompts are easy to validate for type, size, etc. And it's simple to human-engineer a helpful request for re-entry.
- Most debugging is done quickly on live data, rather than waiting for a lengthy compilation process with vast output.

In ending this series on TEX, I'd like to say that I have been a programmer for over 29 years, and I've never felt before that so much problem-solution power was available for me to use so easily. □

# GP Monitor for M6800

The GP Monitor Ver 2.1 written for the Motorola M6800 uses only the INEE (E1AC<sub>16</sub>) and OUTEE (E1D1<sub>16</sub>) Software UART subroutines in the MC6830 L7 ROM. These vectors can be changed as required to any input routine and output routine that does not alter the B or X registers. The input routine must mask Bit 7 of the A register.

e.g.:

```
AND A #%01111111
RTS
```

The Monitor is tucked away at the very top of contiguous RAM in each version. Four versions are supplied:

4K, 8K, 16K, 32K

The Monitor occupies the uppermost 4C1<sub>16</sub> bytes in each version and is protected against accidental alteration by the Monitor subroutines (the DANGER subroutine is used extensively).

The result is a virtually fool-proof general purpose Monitor useful for a variety of applications.

The Monitor accepts 18 commands from an ASCII terminal connected to an M6800 system using the MCM6830 L7 MIKBUG ROM.

When resident, the Monitor accepts input commands described as follows:

The CP Monitor has two modes of operation:  
COMMAND MODE / EXECUTION MODE

The user may input two-character mnemonics which causes the Monitor to perform the selected operation. Once the operation has been performed, the Monitor re-enters command mode. All command mnemonics are followed by a comma delimiter. All address blocks are separated by commas.

e.g.:

```
MM,0000,03FF,1000
```

Valid commands are:

LD	Load Data	TM	Test Memory
DD	Dump Data	LT	Load a Tape
LM	Load Memory	PT	Punch a Tape
DM	Dump Memory	PB	Punch a BNPF Tape
SB	Search for a Byte	CO	Calculate HEX Offsets
SW	Search for a Word	MM	Move Memory Block
CS	Call a Subroutine	CM	Clear Memory
CA	Convert ASCII	(ESC,ESC)	Go To Alternate Monitor
P1	Call Program #1	P2	Call Program #2

## LOAD DATA INTO MEMORY

LD,DDDD D is Destination Start Address

Load data as input on terminal and store into memory starting at location DDDD. Each input increments storage pointer. If data is not stored into RAM (e.g. ROM), routine ABORTS and Command Mode are reentered.

To terminate a string of data, press ESCape key. Terminal responds by printing AAAA BB, where A is next available storage address and B is HEX count of characters entered (up to FF(255)).

## DUMP ASCII DATA FROM MEMORY

DD,SSSS S is start address of dump

Dump data from memory to terminal starting at location S and ending when an EOT (04<sub>16</sub>) is encountered. When EOT occurs, Monitor returns to command mode.

## LOAD MEMORY WITH HEX DATA

LM,SSSS S is start address of storage

e.g.: SSSS = 0000

Terminal responds by:

0010, NEXT LINE (16 Bytes)

Enter comma, etc.

Whenever an exit is desired, hit ESC key and Monitor returns to command mode.

## DUMP MEMORY HEX DATA

DM,SSSS,EEEE S - Starting Address  
E - Ending Address

Terminal responds with:

0000\_11\_22\_33 --- 00

0010\_11\_22 ETC

until Ending address is reached and Monitor returns to command mode.

## SEARCH FOR AN 8 BIT BYTE IN MEMORY

SB,SSSS,EEEE,DD S - Start Address  
E - End Address  
D - Data pattern in HEX

Terminal prints address of each location that contains DD within the S - E range.

## SEARCH FOR A 16 BIT WORD IN MEMORY

SW,SSSS,EEEE,DDDD S - Start Address  
E - End Address  
D - Data pattern in HEX

Terminal prints address of each point in memory that contains two successive 8 bit bytes DDDD.

## CALL A SUBROUTINE FROM MONITOR

CS,DDDD D - Address of Subroutine

Subroutine (or another program) executes, and if terminated with a 39<sub>16</sub> (RTS), Monitor reenters command mode.

## CONVERT ASCII TO HEX EQUIVALENT

CA,A A - Any Valid ASCII Character

Terminal prints HEX equivalent, and Monitor returns to command mode.

## TEST MEMORY ROUTINE

TM,SSSS,EEEE S - Start Address  
E - End Address

Routine responds by clearing locations S through E inclusive. If at any time the start address of the GP Monitor is reached, program aborts and Monitor command mode is reentered.

When memory is cleared, program sequentially increments memory and tests for valid result. This is done for all 256 combinations per bytes for all memory locations selected. An 8K RAM requires about two minutes to test.

# 4K - 8K - 16K or 32K Configuration

Any error in memory causes terminal to print address where error occurred.

When routine finishes, Monitor returns to command mode.

## LOAD A HEX FORMATTED OBJECT TAPE (Must Be Contiguous Data)

LT,DDDD      D - Start Address of  
Contiguous Memory

Object tape is loaded into memory until S9 is read. Monitor returns to command mode.

## PUNCH FOLD-MARK FORMATTED PAPER TAPE

PT,SSSS,EEEE      S - Start Address  
E - End Address

Terminal with paper tape punch outputs object tape with 8½" rubout fold marks.

Leaders and trailers are written to tape with S9 terminator included.

## PUNCH A BNPF FORMATTED OBJECT TAPE

PB,SSSS,EEEE      S - Start Address  
E - End Address

Terminal punches paper tape suitable for most Intel MDS prom-programming system readers.

Leaders, foldmarks and trailers are written to tape.

## CALCULATE HEX OFFSET

```
0010 20 HERE BRA THERE
      (30) CO,0010,0042_30
      ANSWER PRINTED
      BY TERMINAL
0042 20 THERE BRA HERE
      (CC) CO,0042,0010_CC
      ANSWER PRINTED
      BY TERMINAL
```

When finished, Monitor returns to command mode. If branch is out of range, terminal prints an X, and Monitor reenters command mode.

## MOVE A BLOCK OF CONTIGUOUS MEMORY

MM,SSSS,EEEE,DDDD      S - Source Start Address  
E - Source End Address  
D - Destination Start Address

Terminal prints destination end address when block move is complete and Monitor reenters command mode.

## CLEAR CONTIGUOUS MEMORY BLOCK

CM,SSSS,EEEE      S - Start Address  
E - End Address

Routine sets all bits in all memory locations to zero. If Monitor starting address is reached, program aborts and Monitor reenters command mode.

P1 Call user Program #1  
User selected Address

P2 Call user Program #2  
User selected Address

(ESC,ESC) Escape,Escape  
Jump to alternate Monitor

By William E. Warren

## GP MONITOR 4K VERSION

```
2T500B00004D4F4E49544F5220AC
S1I1E0B3E8EA0428D32BD0C2E0A8BDFE1032604A101270E080808080808C2726D3
S1I1E0B59FBD0BDD20DFE02AD0020D9CE0B6B7E0FC0D0A00000FF080000081
S1I1E0B74048DECE0B7C20E0C52454144593E048D19CE0B8CDD020B22A2A2A05
S1I1E0B8F41424F52542A2A048C0B3E27E639FA04ABD0E91CE0BAC8DBF7E9E
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S9030000FC
```

## GP MONITOR 8K VERSION

```
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S9030000FC
```

## GP MONITOR 16K VERSION

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 511E3F721A608047474748DECA6808082E78D5F186202048DE82076E1D1B3  
 510635FD7E1E1AC82  
 592380808FC

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## SAMPLE RUN

```

*H A048
*A048 9C 0B
*A049 FD 3E
*A04A 0B
*H 7E AE FF 9DFF 0B3E A042
*G
READY>LD,0000 THIS IS A TEST .
0013 13
READY>DD,0000 THIS IS A TEST .
0000 00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
0010 00 11 22 33 00  ◀-NON-HEX CHARACTER
ERROR AT - 0014 ***ABORT***
READY>DH,0000,0014
0000 00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
0010 00 11 22 33 00
READY>LH,0722
0722 ,12 34
READY>SB,0000,07FF,12
0722
READY>SV,0000,07FF,1234
0722
READY>DH,0B3E,0B4F
0B3E 8E A0 42 8D 32 BD 0C 2E CE 0B DF E1 00 26 04 A1
0B4E 01 27
READY>MH,0B3E,0B4F,0000 0011 NEW ENDING ADDRESS
0000 8E A0 42 8D 32 BD 0C 2E CE 0B DF E1 00 26 04 A1
0010 01 27
READY>CO,0000,0045 43
READY>CO,0045,0000 B9
READY>CA,G 47
READY>CA,K 4D
READY>CA,L 4C
READY>PB,0000,0003

```

BNNNN PPN FBN PNNNN FBN PNNNN IN FB

[illegible]

## GP MONITOR 32K VERSION

[illegible]

## PROGRAM LISTING

```

00001          NAM      MONITOR
00002          OPT      0,N0G
00003          *
00004          *M6800 GP MONITOR VER 2.1
00005          *REVISED JAN 7/1978
00006          *WRITTEN BY WILLIAM E. WARREN
00007          *
00008          *
00009          *
00010          *
00011          *THIS VERSION FOR 4K RAM SYSTEMS
00012          *
00013          *EQUATES AND REGISTERS
00014          *
00015          A042      STACK EQU      $A042      DEFINE PROGRAM STACK
00016          8007      RDRCON EQU      $8007      READER CONTROL REGISTER
00017          ED00      ALTHW EQU      $ED00      ALTERNATE MONITOR
00018          A04A      ORG      STACK+8
00019          A04A 0002      BFAHEX FMB      2      GENERAL
00020          A04C 0002      TEMPX FMB      2
00021          A04E 0002      TEMPX1 FMB      2      INDEX
00022          A050 0002      TEMPX2 FMB      2
00023          A052 0002      TEMPX3 FMB      2      REGISTER
00024          A054 0002      TEMPX4 FMB      2
00025          A056 0002      TEMPX5 FMB      2      STORAGE
00026          A058 0002      STARTX FMB      2      START ADDRESS VECTOR
00027          A05A 0002      ENDX FMB      2      END ADDRESS VECTOR
00028          A05C 0001      FRCHT FMB      1      FRAMECOUNT REGISTER
00029          A05D 0001      BYTCON FMB      1      BYTE COUNT REGISTER
00030          A05E 0001      CHKSUM FMB      1      CHECKSUM REGISTER
00031          A05F 0001      CNTU FMB      1      8 BIT COUNTER
00032          A060 0002      BUFFER FMB      2      SPECIAL STORAGE
00033          *

```

```

00034 *THIS MONITOR COMMAND ROUTINE
00035 *ACCEPTS TWO-INPUT COMMAND MNEMONICS
00036 *THAT CALL UP THE REQUIRED SUBROUTINE
00037 *
00038 *IF AN ERROR IS MADE ON ENTRY
00039 *THE TERMINAL PRINTS 'INVALID COMMAND'
00040 *AND THE MONITOR IS REENTERED.
00041 *
00042 0B3E ORG $0FFF-$4C1
00043 *
00044 0B3E 8E A042 MONITR LDS #STACK SET STACK
00045 0B41 8D 32 BSR DO PROMPT
00046 0B43 8D 0C2E JSR IN2ASC INPUT COMMANDS
00047 0B46 CE 0BDF LDX #DATA6 POINT TO TABLE
00048 0B49 E1 00 FINDC CMP B 0,X 1ST CHAR?
00049 0B4B 26 04 BNE NEXT4 NOPE
00050 0B4D A1 01 CMP A 1,X 2ND CHAR?
00051 0B4F 27 0E BEQ FOUNDC YES
00052 0B51 08 INX INCREMENT
00053 0B52 08 INX TO
00054 0B53 08 INX NEXT
00055 0B54 08 INX COMMAND
00056 0B55 8C 0C27 CPX #DATA6E END YET?
00057 0B58 26 EF BNE FINDC KEEP LOOKING
00058 0B5A 8D 0BDD JSR INVALD INVALID COMMAND
00059 0B5D 28 DF MONITR BACK TO START
00060 0B5F EE 02 FOUNDC LDX 2,X FETCH ROUTINE ADDRESS
00061 0B61 AD 00 JSR 0,X DO THE ROUTINE
00062 0B63 28 D9 BRA MONITR GO BACK TO START
00063 *
00064 *START A NEW LINE
00065 *
00066 0B65 CE 0B6B NEWLIN LDX #NEWLDT POINT TO DATA
00067 0B68 7E 0FCC PDATA1 JMP PRINT STRING
00068 0B6B 0D NEWLDT FCB $D, $A, 0, 0, 0, 5FF, 0, 0, 0, 4
00069 *
00070 *READY> PRINTOUT SUBROUTINE
00071 *
00072 0B75 8D EE PREADY BSR NEWLIN START NEW LINE FIRST
00073 0B77 CE 0B7C LDX #DATA2
00074 0B7A 28 EC BRA PDATA1 PRINT STRING
00075 0B7C 52 DATA2 FCB 'READY>'
00076 0B82 04 FCB $4
00077 *
00078 *ABORT PRINTOUT SUBROUTINE
00079 *
00080 0B83 8D 19 PABORT BSR PERROR
00081 0B85 CE 0B8C LDX #DATA3
00082 0B88 8D DE BSR PDATA1
00083 0B8A 20 B2 BRA MONITR
00084 0B8C 2A DATA3 FCB '***ABORT***'
00085 0B97 04 FCB $4
00086 *
00087 *MONITOR OVERWRITE PROTECTION ROUTINE
00088 *
00089 0B98 8C 0B3E DANGER CPX #MONITR IS X NEAR MONITOR?
00090 0B9B 27 E6 BEQ PABORT YES GET OUT QUICK
00091 0B9D 39 RTS NO ITS OK
00092 *
00093 *ERROR PRINTOUT SUBROUTINE
00094 *
00095 0B9E FF A04A PERROR STX BFAHEX SAVE ADDRESS OF ERROR
00096 0BA1 8D 0E91 JSR OUT TURN OFF READER(IF ON)
00097 0BA4 CE 0BAC LDX #DATA4 POINT AT MESSAGE
00098 0BA7 8D BF BSR PDATA1 PRINT IT
00099 0BA9 7E 0CB2 JMP LADDR PRINT ADDRESS
00100 0BAC 0D DATA4 FCB $D, $A, 0, 0, 0
00101 0BB1 45 FCB 'ERROR AT -'
00102 0BBC 04 FCB 4
00103 *
00104 *INVALID COMMAND MESSAGE
00105 *
00106 0BBD CE 0B03 INVALD LDX #IVAPRT
00107 0BBD 7E 0FCC JMP PDATA1
00108 0B03 28 IVAPRT FCB 'INVALID COMMAND'
00109 0B04 04 FCB $4
00110 *
00111 *PINCH 64 NULL LEADER/TRAILER
00112 *
00113 0BD5 C6 40 P64NIL LDA B #64
00114 0BD7 4F PNL CLR A
00115 0BD8 8D 0FFA JSR CPRINT
00116 0BD8 5A DEC B
00117 0BDC 26 F9 BNE PNL
00118 0BDE 39 RTS
00119 *
00120 *COMMAND TABLE
00121 *
00122 0BD5 4C DATA6 FCB 'LD' LOAD DATA
00123 0BE1 0CF3 FDB LODAT
00124 0BE3 44 FCB 'DD' DUMP DATA
00125 0BE5 0D21 FDB DUDAT
00126 0BE7 4C FCB 'LM' LOAD MEMORY
00127 0BE9 0D26 FDB LOMEM
00128 0BEB 44 FCB 'DM' DUMP MEMORY
00129 0BED 0DB8 FDB DIMEM
00130 0BEF 53 FCB 'SB' SEARCH MEMORY FOR 8 BIT BYTE
00131 0BF1 0D68 FDB SERMEM
00132 0BF3 43 FCB 'CM' CLEAR MEMORY
00133 0BF5 0D55 FDB CLMEM
00134 0BF7 43 FCB 'CS' CALL SUBROUTINE
00135 0BF9 0C9D FDB CALSUB
00136 0BF8 4D FCB 'MM' MOVE MEMORY BLOCKS
00137 0BF9 0CB8 FDB MOVMEM
00138 0BF5 53 FCB 'SV' SEARCH MEMORY FOR 16 BIT WORD
00139 0C01 0D94 FDB SERADD
00140 0C03 4C FCB 'LT' LOAD TAPE WITH OFFSET
00141 0C05 0E70 FDB OFLOAD
00142 0C07 58 FCB 'PT' PUNCH FORMATTED PAPER TAPE
00143 0C09 0ED5 FDB PUNTAB
00144 0C0B 54 FCB 'TM' TEST MEMORY
00145 0C0D 0E25 FDB TSTMEN
00146 0C0F 43 FCB 'CO' CALCULATE HEX OFFSET
00147 0C11 0DE3 FDB CALOFF
00148 0C13 43 FCB 'CA' CONVERT ASCII TO HEX
00149 0C15 0E62 FDB CONASC
00150 0C17 1B FCB $1B, $1B (ESC,ESC) GO TO ALTERNATE MON
00151 0C19 0ED8 FDB ALTHON
00152 0C1B 58 FCB 'PB' PUNCH BPPF TAPE
00153 0C1D 0F64 FDB PUNBNF
00154 0C1F 58 FCB 'P1' GO TO PROGRAM ONE
00155 0C21 0B3E FDB MONITR USER VECTOR GOES HERE
00156 0C23 58 FCB 'P2' GO TO PROGRAM TWO
00157 0C25 0B3E FDB MONITR USER VECTOR GOES HERE
00158 0C27 FF DATA6 FCB $FF END OF COMMAND TABLE

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00159 *
00160 *CONNECTING JUMPS
00161 *
00162 0C28 7E 0B83 JMP1 JMP PABORT
00163 0C2B 7E 0B3E JMP2 JMP MONITR
00164 *
00165 *INPUT 2 ASCII CHARACTERS INTO B AND A
00166 *
00167 0C2E 8D 0FFD IN2ASC JSR CINPOT FIRST CHAR
00168 0C31 16 TAB PUT IN B
00169 0C32 7E 0FFD INASC JMP CINPOT FETCH SECOND CHAR AND RTS
00170 *
00171 *MAKE HEX FROM DATA IN A
00172 *IF NON HEX THEN DO ERROR
00173 *AND VECTOR BACK TO MONITOR
00174 *
00175 0C35 58 30 MAKHEX SUB A #530 STRIP ASCII
00176 0C37 28 0F BMI NOTHEX
00177 0C39 81 09 CMP A #509 0 TO 9 HEX?
00178 0C3B 2F 0A BLE HEX
00179 0C3D 81 11 CMP A #511
00180 0C3F 2B 07 BMI NOTHEX
00181 0C41 81 16 CMP A #516
00182 0C43 2E 03 BGT NOTHEX
00183 0C45 80 07 SUB A #507
00184 0C47 39 HEX RTS
00185 0C48 81 EB NOTHEX CMP A #5EB OK, EXIT
00186 0C4A 26 DC BNE JMP1 'ESC' KEY?
00187 0C4C 28 DD BRA JMP2 HEX ERROR
00188 *
00189 *INPUT ONE HEX INTO A
00190 *
00191 0C4E 8D E2 IN1HEX BSR INASC FETCH CHAR
00192 0C50 28 E3 BRA MAKHEX
00193 *
00194 *INPUT 2 HEX INTO A
00195 *UPDATE CHECKSUM
00196 *
00197 0C52 37 IN2HEX PSH B SAVE B
00198 0C53 8D F9 BSR IN1HEX
00199 0C55 48 ASL A
00200 0C56 48 ASL A
00201 0C57 48 ASL A
00202 0C58 48 ASL A
00203 0C59 16 TAB SHIFT TO UPPER B
00204 0C5A 8D F2 BSR IN1HEX GET LOWER
00205 0C5C 18 ABA MAKE A BYTE
00206 0C5D 36 PSH A SAVE DATA
00207 0C5E BB A05E ADD A CHKSUM FETCH CHECKSUM
00208 0C61 B7 A05E STA A CHKSUM UPDATE
00209 0C64 32 PUL A RESTORE DATA
00210 0C65 33 PUL B RESTORE B
00211 0C66 39 RTS DONE
00212 *
00213 *INPUT 4 HEX INTO X AND
00214 *ALSO STORE AT BFAHEX
00215 *
00216 0C67 37 IN4HEX PSH B
00217 0C68 36 PSH A
00218 0C69 8D E7 BSR IN2HEX SAVE ACC
00219 0C6B 16 TAB FETCH HI BYTE
00220 0C6C 8D E4 BSR IN2HEX PUT IN B
00221 0C6E CE A04A LDX #BFAHEX FETCH LO BYTE
00222 0C71 E7 00 STA B 0,X POINT AT DATA
00223 0C73 A7 01 STA A 1,X PUT IN BUFFER
00224 0C75 EE 00 LDX 0,X FETCH INTO X
00225 0C77 32 PUL A
00226 0C78 33 PUL B
00227 0C79 39 RTS
00228 *
00229 *CONTINUE (,) OR ESCAPE (ESC)
00230 *
00231 0C7A 8D B6 CONTIN BSR INASC FETCH CHAR
00232 0C7C 81 1B CMP A #51B 'ESC' ?
00233 0C7E 27 AB BEQ JMP2
00234 0C80 81 2C CMP A #, COMMA ?
00235 0C82 26 F6 BNE CONTIN NO JUST WAIT
00236 0C84 39 RTS DONE, GO
00237 *
00238 *CONTROLLED INPUT 2 HEX
00239 *IN FORM ,HH
00240 *
00241 0C85 8D F3 CIN2HX BSR CONTIN
00242 0C87 28 C9 BRA IN2HEX FETCH BYTE
00243 *
00244 *CONTROLLED INPUT 4 HEX
00245 *IN FORM ,HHHH
00246 *
00247 0C89 8D EF CIN4HX BSR CONTIN WAIT FOR COMMA
00248 0C8B 28 DA BRA IN4HEX
00249 *
00250 *INPUT 3 SETS OF 4 HEX
00251 *IN FORM ,HHHH,HHHH,HHHH
00252 *
00253 0C8D 8D FA I3HEX4 BSR CIN4HX
00254 0C8F FF A04E STX TEMPX1
00255 0C92 8D F5 BSR CIN4HX
00256 0C94 FF A058 STX TEMPX2
00257 0C97 8D F8 BSR CIN4HX
00258 0C99 FF A052 STX TEMPX3
00259 0C9C 39 RTS
00260 *
00261 *CALL SUBROUTINE POINTED TO
00262 *BY ADDRESS IN X
00263 *
00264 0C9D 8D EA CALSUB BSR CIN4HX FETCH THE ADDRESS
00265 0C9F AD 08 JSR 0,X JUMP TO IT
00266 0CA1 7E 0B3E JMP MONITR BACK TO MONITOR
00267 *
00268 *INPUT TWO SETS OF 4 HEX
00269 *IN FORM ,HHHH,HHHH
00270 *
00271 0CA4 8D E3 IN2HX4 BSR CIN4HX FIRST ADDRESS
00272 0CA6 FF A058 STX STARTX
00273 0CA9 8D DE BSR CIN4HX
00274 0CAB FF A05A STX ENDX SECOND ADDRESS
00275 0CAE 39 RTS
00276 *
00277 *START NEW LINE AND PRINT ADDRESS
00278 *
00279 0CAF 8D 0B65 NLADDR JSR NEWLIN
00280 0CB2 CE A04A LADDR LDX #BFAHEX POINT AT DATA
00281 0CB5 7E 0FF6 JMP P4HEX PRINT IT
00282 *
00283 *MOVE MEMORY BLOCK ROUTINE

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00284      *
00285 0CB8 8D D3 MOVEM BSR I3HEX4  FETCH PARAMETERS
00286 0CBA FE A04E DRCTM LDX TMPX1  DIRECT ENTRY POINT
00287 0CBD A6 00 LDA A 0,X
00288 0CBF BC A050 CPX TMPX2  SOURCE DATA
00289 0CC2 27 19 BEQ LASTBY
00290 0CC4 00 INX
00291 0CC5 FF A04E STX TMPX1
00292 0CC8 FE A052 LDX TMPX3  DESTINATION
00293 0CCB BD 0B98 JSR DANGER  BE CAREFUL
00294 0CCE A7 00 STA A 0,X  STORE DATA
00295 0CD0 A1 00 CMP A 0,X  CHECK IF THERE
00296 0CD2 27 03 BEQ DRC1  ITS OK
00297 0CD4 7E 0B83 JMP PABORT  NO MEMORY
00298 0CD7 00 DRC1 INX
00299 0CD8 FF A052 STX TMPX3
00300 0CD8 20 DD BRA DRC1M
00301 0CDD FE A052 LASTBY LDX TMPX3
00302 0CE8 A7 00 STA A 0,X
00303 0CE2 BD 0FF2 JSR SPACE
00304 0CE5 CE A052 LDX #TMPX3  POINT TO DATA
00305 0CE8 7E 0FF6 JMP P4HEX5  PRINT IT AND EXIT
00306
00307      *LINKS
00308
00309 0CEB 7E 0C89 JMP3 JMP CIN4HX
00310 0CEE 7E 0C7A JMP4 JMPA
00311 0CF1 20 B1 JMP6 BRA IN2HX4
00312
00313      *LOAD DATA INTO MEMORY
00314
00315 0CF3 8D F6 LODAT BSR JMP3  FETCH DESTINATION X
00316 0CF5 7F A05F CLR COUNTU
00317 0CF8 BD 0FFD LODAT1 JSR CINPUT
00318 0CFB 81 10 CMP A #510  "ESC"7
00319 0CFD 27 1A BEQ QUITDA
00320 0CFF FE A04A LDX BFAHEX  FETCH ADDR
00321 0D02 BD 0B98 JSR DANGER  BE CAREFUL
00322 0D05 A7 00 STA A 0,X
00323 0D07 A1 00 CMP A 0,X
00324 0D09 27 03 BEQ LODAT2
00325 0D0B 7E 0B83 JMP PABORT  NO RAM
00326 0D0E 00 LODAT2 INX
00327 0D0F FF A04A STX BFAHEX  RESTORE BUF
00328 0D12 7C A05F INC COUNTU  INCREMENT COUNT
00329 0D15 27 02 BEQ QUITDA  YES EXIT
00330 0D17 20 DF BRA LODAT1
00331 0D19 8D 94 QUITDA BSR NLADDR  PRINT ADDR
00332 0D1B B6 A05F LDA A 0,X  FETCH BYTE COUNT
00333 0D1E 7E 0F46 JMP P2HEXA  PRINT IT AND RTS
00334
00335      *DUMP DATA ROUTINE
00336
00337 0D21 8D C8 DUDAT BSR JMP3
00338 0D23 7E 0FCC JMP PDATA  PRINT STRING UNTIL EDT
00339
00340      *LOAD MEMORY SEQUENTIALLY
00341      *WITH HEX DATA
00342
00343 0D26 8D C3 LOMEM BSR JMP3
00344 0D28 7F A05F LOMEM1 CLR COUNTU
00345 0D2B BD 0CAF JSR NLADDR
00346 0D2E BD 0E BSR JMP4
00347 0D30 BD 0C52 LOMEM2 JSR IN2HEX  CONTIN
00348 0D33 7C A05F INC COUNTU  INCREMENT BYTE COUNT
00349 0D36 FE A04A LDX BFAHEX
00350 0D39 BD 0B98 JSR DANGER  BE CAREFUL
00351 0D3C A7 00 STA A 0,X
00352 0D3E A1 00 CMP A 0,X  IS IT THERE?
00353 0D40 27 03 BEQ LOMEM3  YES OK
00354 0D42 7E 0B83 JMP PABORT  NOT THERE
00355 0D45 00 LOMEM3 INX
00356 0D46 FF A04A STX BFAHEX
00357 0D49 B6 A05F LDA A 0,X  COUNTU
00358 0D4C 81 10 CMP A #16
00359 0D4E 27 00 BEQ LOMEM1
00360 0D50 BD 0FF2 JSR SPACE
00361 0D53 20 DD BRA LOMEM2
00362
00363      *CLEAR MEMORY ROUTINE
00364
00365 0D55 8D 9A CLMEM BSR JMP6
00366 0D57 FE A058 LDX STARTX
00367 0D5A BD 0B98 CLM JSR DANGER  BE CAREFUL
00368 0D5D 6F 00 CLR 0,X  CLEAR A LOCATION
00369 0D5F BC A05A CPX BNIX  END YET?
00370 0D62 27 03 BEQ DONE  YES EXIT
00371 0D64 00 INX
00372 0D65 20 F3 BRA CLM
00373 0D67 39 DONE RTS
00374
00375      *SEARCH MEMORY FOR 8 BIT BYTE
00376
00377 0D68 8D 87 SERM BSR JMP6
00378 0D6A FE A058 LDX STARTX
00379 0D6D FF A04A STX BFAHEX
00380 0D70 BD 0C85 JSR CIN2HX
00381 0D73 16 TAB
00382 0D74 FE A04A LDX BFAHEX
00383 0D77 A6 00 SEARCH LDA A 0,X
00384 0D79 11 CBA
00385 0D7A 27 00 BEQ DISADD
00386 0D7C BC A05A CPX BNIX
00387 0D7F 27 E6 BEQ DONE
00388 0D81 00 SERINX INX
00389 0D82 20 F3 BRA SEARCH
00390 0D84 FF A04A DISADD STX BFAHEX
00391 0D87 37 PSH B
00392 0D88 BD 0CAF JSR NLADDR
00393 0D8B 33 PUL B
00394 0D8C FE A04A LDX BFAHEX
00395 0D8F 20 F0 BRA SERINX
00396
00397      *LINK
00398
00399 0D91 7E 0C8D JMP7 JMP I3HEX4
00400
00401      *SEARCH FOR 16 BIT WORD IN MEMORY
00402
00403 0D94 8D FB SERADD BSR JMP7  INPUT PARAMETERS
00404 0D96 FE A04E LOOPDO LDX TMPX1  START ADDR
00405 0D99 BC A050 LOOPAG CPX TMPX2  END ADDR
00406 0D9C 27 C9 BEQ DONE  FINISHED SO EXIT
00407 0D9E A6 00 LDA A 0,X  FETCH HI BYTE
00408 0DA0 E6 01 LDA B 1,X  FETCH LO BYTE
00409 0DA2 B1 A052 CMP A TMPX3  COMPARE HIBYTE
00410 0DA5 26 05 BNE SEREXC  CONTINUE
00411 0DA7 F1 A053 CMP B TMPX3+1  COMPARE LO BYTE
00412 0DAA 27 03 BEQ FONDSR  FOUND ONE
00413 0DAC 00 SEREXC INX
00414 0DAD 20 EA BRA LOOPAG  DO AGAIN
00415 0DAF FF A04A FONDSR STX BFAHEX  SAVE ADDRESS
00416 0DB2 00 INX
00417 0DB3 FF A04E STX TMPX1  SAVE NEXT ADDRESS
00418 0DB6 BD 0CAF JSR NLADDR  PRINT ADDRESS WHERE FOUND
00419 0DB9 20 DB BRA LOOPDO  KEEP GOING
00420
00421      *DUMP MEMORY
00422
00423 0DBB BD 0CA4 DIMEM JSR IN2HX4  FETCH ADDRESS LIMITS
00424 0DBE FE A058 LDX STARTX  FETCH START X
00425 0DC1 FF A04A CONTM STX BFAHEX  SAVE ADDRESS
00426 0DC4 BD 0CAF JSR NLADDR  START NEW LINE AND PRINT ADDR
00427 0DC7 86 10 LDA A #16  SET BYTE COUNT
00428 0DC9 B7 A05F STA A 0,X  INTO REGISTER
00429 0DCC FE A04A DIMLOP LDX BFAHEX  FETCH POINTER
00430 0DCF 09 DEX
00431 0DD0 BC A05A CPX BNIX  END YET?
00432 0DD3 27 92 BEQ DONE  YES EXIT
00433 0DD5 00 INX  BACK UP
00434 0DD6 BD 0FF0 JSR HPRINT  PRINT BYTE POINTED AT
00435 0DD9 FF A04A STX BFAHEX  SAVE POINTER
00436 0DDC 7A A05F DEC COUNTU  REDUCE BYTECOUNT
00437 0DDF 26 EB BNE DIMLOP  KEEP GOING
00438 0DE1 20 DE BRA CONTM  LINE DONE , DO ANOTHER
00439
00440      *CALCULATE OFFSETS AND PRINT RESULT
00441      *IF BRANCH IS OUT OF RANGE
00442      *AN "X" WILL BE PRINTED
00443
00444
00445 0DE3 CALOFF EQU *
00446 0DE3 BD 0CA4 JSR IN2HX4  FETCH ADDRESS LIMITS
00447 0DE6 5F CLR B
00448 0DE7 5A DEC B
00449 0DE8 5A DEC B  SET OFFSET START VALUE
00450 0DE9 FE A058 LDX STARTX  FETCH POINTER
00451 0DEC B6 A058 LDA A 0,X  HI BYTE
00452 0DEF B1 A05A CMP A BNIX  UP OR DOWN ?
00453 0DF2 22 15 BHI DELOP  NEGATIVE BRANCH
00454 0DF4 B6 A059 LDA A 0,X  LO BYTE
00455 0DF7 B1 A058 CMP A BNIX+1  UP OR DOWN ?
00456 0DFA 22 0D BHI DELOP  NEGATIVE BRANCH
00457 0DFC BC A05A CNLOP CPX BNIX  DONE YET?
00458 0DF7 27 15 BEQ DONCAL  YES EXIT
00459 0E01 00 INX  INCREMENT POINTER
00460 0E02 5C INC B  INCREMENT VALUE
00461 0E03 C1 00 CMP B #500  OUT OF RANGE?
00462 0E05 27 16 BEQ OUTRAN  YES
00463 0E07 20 F3 BRA CNLOP  KEEP GOING
00464 0E09 BC A05A DELOP CPX BNIX  DONE YET?
00465 0E0C 27 08 BEQ DONCAL  YES EXIT
00466 0E0E 09 DEX  DECREMENT POINTER
00467 0E0F 5A DEC B  DECREMENT COUNT
00468 0E10 C1 7F CMP B #57F  OUT OF RANGE?
00469 0E12 27 09 BEQ OUTRAN  YES EXIT
00470 0E14 20 F3 BRA DELOP  KEEP GOING
00471 0E16 BD 0FF2 DONCAL JSR SPACE  PRINT A SPACE
00472 0E19 17 TAB  TRANSFER VALUE
00473 0E1A 7E 0F46 JMP P2HEXA  PRINT IT AND EXIT
00474 0E1D BD 0FF2 OUTRAN JSR SPACE
00475 0E20 86 58 LDA A #X  SET ASCII
00476 0E22 7E 0FFA JMP CPRINT  PRINT IT AND EXIT
00477
00478      *TEST MEMORY
00479
00480 0E25 BD 0CA4 TSTMEM JSR IN2HX4  FETCH START AND END
00481 0E28 BD 0D57 JSR CLMEM+2  CLEAR MEMORY FIRST
00482 0E2B FE A058 AGAIN LDX STARTX
00483 0E2E A6 00 TEST LDA A X  FETCH DATA
00484 0E30 AC TEST1 INC A  INCREMENT A
00485 0E31 A7 00 STA A X
00486 0E33 B7 A060 STA A 0,X  BUFFER
00487 0E36 E6 00 LDA B X
00488 0E38 F7 A061 STA B 0,X  BUFFER+1  SAVE FETCHED VALUE
00489 0E3B 11 CBA
00490 0E3C 26 08 BNE THERR
00491 0E3E BC A05A CPX BNIX  THERR
00492 0E41 27 1A BEQ EXIT
00493 0E43 00 INX
00494 0E44 20 E8 BRA TEST
00495 0E46 FF A04A THERR STX BFAHEX
00496 0E49 BD 0B9E JSR PERROR
00497 0E4C CE A060 LDX #BUFFER  SET X TO VALUES
00498 0E4F BD 0FF0 JSR HPRINT  PRINT FIRST TWO
00499 0E52 BD 0FF0 JSR HPRINT  AND SECOND TWO
00500 0E55 FE A04A LDX BFAHEX  RESTORE X
00501 0E58 B6 A060 LDA A 0,X  BUFFER
00502 0E5B 20 D3 BRA TEST1  RESTORE DATA
00503 0E5D 81 FF EXIT CMP A #5FF  ALL PATTERNS YET?
00504 0E5F 26 CA BNE AGAIN  NO DO AGAIN
00505 0E61 39 RTS
00506
00507      *CONVERT ASCII TO HEX
00508
00509 0E62 CONASC EQU *
00510 0E62 BD 0C7A JSR CONTIN
00511 0E65 BD 0FFD JSR CINPUT
00512 0E68 36 CON1 PSH A
00513 0E69 BD 0FF2 JSR SPACE
00514 0E6C 32 PUL A
00515 0E6D 7E 0F46 JMP P2HEXA
00516
00517      *OFFSET LOADER ROUTINE
00518      *IN FORMAT LT,DDDD
00519      *WHERE D IS DESTINATION
00520
00521 0E70 OFLOAD EQU *
00522 0E70 BD 0C89 JSR CIN4HX  FETCH ACTUAL STORAGE ADDRESS
00523 0E73 FF A04E STX TMPX1  SET POINTER
00524 0E76 86 11 LDA A #511
00525 0E78 8D 58 BSR PRINT  TURN ON READER COMMAND
00526 0E7A 86 3C LDA A #53C
00527 0E7C B7 0007 STA A 0,X  RDRCON
00528 0E7F BD 0FFD OLIN JSR CINPUT  FETCH A CHARACTER
00529 0E82 81 53 CMP A #5
00530 0E84 26 F9 BNE OLIN  NOT YET
00531 0E86 BD 0FFD JSR CINPUT  ANOTHER
00532 0E89 81 31 CMP A #1

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00533 0E8B 27 11      BEQ  LOAD  OK START
00534 0E8D 31 39      CMP A  #'9  END?
00535 0E8F 26 EE      BNE  OLIN  NO KEEP LOOKI
00536 0E91 86 34      LDA A  #3C4  TURN OFF READER
00537 0E93 87 0077    STA A  #RDCON  TURN OFF READER
00538 0E96 86 13      LDA A  #13
00539 0E98 8D 38      BSR  PRINT  READER OFF COMMAND
00540 0E9A 39          RTS  EXIT
00541 0E9B 7E 0C52    INHX2 JMP  IN2HEX
00542 0E9E 7F A05E    LOAD  CLR  CHKSUM  RESET CHECKSUM
00543 0EA1 8D F8      BSR  INHX2  FETCH CHARACTER COUNT
00544 0EA3 88 02      SUB A  #2  SUBTRACT TWO
00545 0EA5 87 A85D    STA A  BYTONT  SET BYTE COUNT
00546 0EA8 BD C67     JSR  IN4HEX  FETCH ADDRESS
00547 0EAB FE A04E    LDH  TEMPX1  USE NEW OFFSET ADDRESS
00548 0EAE 8D EB      LOADST BSR  INHX2  FETCH A DATA BYTE
00549 0E80 8D 0098    JSR  DANGER  BE CAREFUL
00550 0EB3 7A A85D    DEC  BYTONT  REDUCE BYTECOUNT
00551 0EB6 27 09      BEQ  CHECK  IF LINE IS FULL
00552 0EB8 A7 00      STA A  X  NO JUST PUT IN MEMORY
00553 0EBA A1 00      CMP A  X  IS IT THERE?
00554 0EBC 26 00      BNE  ABORT  NO MUST BE ROM
00555 0EBE 08          INX
00556 0EBF 2D ED      BRA  LOADST  OK KEEP STORING
00557 0EC1 FF A04E    CHECK STX  TEMPX1  SAVE STORAGE POINTER
00558 0EC4 7C A05E    INC  CHKSUM  CHECKSUM OK?
00559 0EC7 27 B6      BEQ  OLIN  YES IT IS
00560 0EC9 86 3F      ABORT LDA A  #3F
00561 0ECB 8D 05      BSR  PRINT  PRINT "??"
00562 0ECD 8D C2      BSR  OUT 2H
00563 0ECF 7E 0B9E    JMP  PERROR
00564 0ED2 7E 0FFA    PRINT JMP  CPRINT
00565
*OBJECT CODE DUMP ROUTINE
00566
00567
00568 0ED5 BD 0CA4    PINTAB JSR  IN2HX4  FETCH ADDRESS PARAMETERS
00569 0ED8 86 12      LDA A  #12  SET DATA
00570 0EDA 8D F6      BSR  PRINT  START PUNCH
00571 0EDC BD 0BD5    JSR  P64NUL  FEED OUT LEADER
00572 0EDF FE A058    LDH  STARTX  FETCH ADDRESS
00573 0EE2 FF A04C    STX  TEMPX  SAVE IT
00574 0EE5 86 A05B    DIM1 LDA A  BNDX+1
00575 0EE8 88 A04D    SUB A  TEMPX+1
00576 0EEB F6 A05A    LDA B  BNDX
00577 0EEE F2 A04C    SBC B  TEMPX
00578 0EF1 26 04      BNE  DIM2
00579 0EF3 81 20      CMP A  #32  32 BYTES PER RECORD
00580 0EF5 25 02      BCS  DIM3
00581 0EF7 86 1F      DIM2 LDA A  #31
00582 0EF9 8B 04      DIM3 ADD A  #4
00583 0EFB 87 A05C    STA A  FRCNT  SET FRAME COUNT
00584 0EFE 88 03      SUB A  #3
00585 0F00 87 A05D    STA A  BYTONT  SET BYTE COUNT
00586 0F03 BD 0B65    JSR  NEWLIN  START NEW LINE
00587 0F06 CE 0F61    LDH  #TPSTRG  POINT AT TAPE STRING
00588 0F09 BD 0FCC    JSR  PDATA  PRINT THE STRING
00589 0F0C 7F A05E    CLR  CHKSUM
00590 0F0F CE A05C    LDH  #FRCNT
00591 0F12 8D 39      BSR  OUT2H  PRINT FRAMECOUNT
00592 0F14 CE A04C    LDH  #TEMPX  FETCH POINTER
00593 0F17 8D 44      BSR  OUT4HX  PRINT ADDRESS
00594 0F19 FE A04C    LDH  TEMPX  SET POINTER
00595 0F1C 8D 2F      DIM4 BSR  OUT2H  PRINT THE DATA
00596 0F1E 7A A05D    DEC  BYTONT  REDUCE BYTE COUNT
00597 0F21 26 F9      BNE  DIM4  KEEP DUMPING
00598 0F23 FF A04C    STX  TEMPX  SAVE ADDRESS POINTER
00599 0F26 7F A05E    COM  CHKSUM  INVERT
00600 0F29 CE A05E    LDH  #CHKSUM  SET POINTER
00601 0F2C 8D 1F      BSR  OUT2H  PRINT CHECKSUM
00602 0F2E FE A04C    LDH  TEMPX  FETCH ADDRESS
00603 0F31 09          DEX  BACK ONE
00604 0F32 BC A05A    CPX  BNDX  WAS IT THE END?
00605 0F35 26 AE      BNE  DIM1  NO KEEP GOING
00606 0F37 86 53      LDA A  #'S  SET AN S
00607 0F39 8D 97      BSR  PRINT  PRINT IT
00608 0F3B 86 39      LDA A  #'9  AND A NINE
00609 0F3D 8D 93      BSR  PRINT  PRINT ALSO
00610 0F3F BD 0BD5    JSR  P64NUL  FEED OUT TRAILER AND RTS
00611 0F42 86 1A      LDA A  #1A  SET DATA
00612 0F44 2D 8C      BRA  PRINT  TURN OFF PUNCH
00613
*OUTPUT TWO HEX FROM DATA IN A
00614
*X REGISTER ALTERED
00615
00616
00618 0F46 36          P2HXDA PSH A  SAVE A DATA
00619 0F47 38          TSX  POINT AT DATA
00620 0F48 BD 0FE3    JSR  P2HXDA  PRINT IT
00621 0F4B 32          PUL A  RESTORE STACK
00622 0F4C 39          RTS  EXIT
00623
*OUTPUT TWO HEX CHARACTERS
00624
*FROM DATA POINTED AT BY X
00625
*CHECKSUM IS UPDATED
00626
*X IS INCREMENTED ONCE
00627
00628
00629 0F4D 37          OUT2H PSH B  SAVE B
00630 0F4E BD 0FE3    JSR  P2HXDA  PRINT THE DATA
00631 0F51 09          DEX  BACK ONE ADDRESS
00632 0F52 E6 00      LDA B  0,X
00633 0F54 08          INX
00634 0F55 FB A05E    ADD B  CHKSUM
00635 0F58 F7 A05E    STA B  CHKSUM  RESTORE CHECKSUM
00636 0F5B 33          PUL B  RESTORE B REG
00637 0F5C 39          RTS
00638
*OUTPUT FOUR HEX CHARACTERS
00639
*FROM ADDRESS POINTED AT BY X
00640
*CHECKSUM UPDATED ACCORDINGLY
00641
*X IS INCREMENTED TWICE
00642
00643
00644 0F5D 8D EE      OUT4HX BSR  OUT2H  DO FIRST BYTE
00645 0F5F 28 EC      BRA  OUT2H  DO THE SECOND AND EXIT
00646
*TAPE FORMAT STRING
00647
00648
00649 0F61 53          TPSTRG FCB  'S' '1.4'
00650
*BNPF TAPE PUNCH ROUTINE FOR 8 BIT PROMS
00651
*FORMAT SUITABLE FOR MOST MDS READERS
00652
*SELECT PARAMETERS IN FORM PB,SSSS,EEEE
00653
*WHERE S IS START ADDRESS AN E IS END ADDRESS
00654
*INCLUSIVE LEADERS AND TRAILERS ARE
00655
*WRITTEN TO TAPE AND THE TAPE IS PUNCHED
00656
*WITH 8 1/2 INCH FOLD MARKS
00657

```

```

00658
*
00659 0F64 BD 0CA4    PUNENF JSR  IN2HX4  FETCH PARAMETERS
00660 0F67 FE A05A    LDH  INDX  FETCH END
00661 0F6A 08          INX  AND ADD ONE
00662 0F6B FF A04E    STX  TEMPX1  TO IT AND STORE
00663 0F6E 86 12      LDA A  #12  SET DATA
00664 0F70 BD 0FFA    JSR  CPRINT  TO TURN PUNCH ON
00665 0F73 BD 0BD5    JSR  P64NUL  DO NUL LEADER
00666 0F76 8D 2C      BSR  RUBOUT  DO RUBOUTS
00667 0F78 2D 03      BRA  BYTE2  SKIP NEW LINE
00668 0F7A BD 0B65    BYTE1 JSR  NEWLIN  START NEW LINE
00669 0F7D C6 08      BYTE2 LDA B  #8  SET BYTE COUNT PER LINE
00670 0F7F 86 42      BYTE3 LDA A  #'B  SET ASCII
00671 0F81 8D 77      BSR  CPRINT  PRINT A B
00672 0F83 FE A058    LDH  STARTX  FETCH POINTER
00673 0F86 BC A05A    CPX  INDX  END YET?
00674 0F89 27 11      BEQ  ENDPIN  YES IT IS
00675 0F8B A6 00      LDA A  0,X  FETCH THE DATA
00676 0F8D 08          INX  INCREMENT POINTER
00677 0F8E FF A058    STX  STARTX  SAVE X AGAIN
00678 0F91 8D 1B      BSR  BITLOP  PRINT A BYTE
00679 0F93 86 46      LDA A  #'F  SET ASCII
00680 0F95 8D 63      BSR  CPRINT  PRINT AN F
00681 0F97 5A          DEC B  DECREMENT BYTE COUNT
00682 0F98 26 E5      BNE  KEEP GOING
00683 0F9A 2D DE      BRA  BYTE1  LINE DONE DO ANOTHER
00684 0F9C C6 64      ENDPIN LDA B  #100  SET COUNT
00685 0F9E 8D 06      BSR  RUB1  DO RUBOUTS
00686 0FA8 86 14      LDA A  #14  SET CONTROL
00687 0FA2 2D 56      BRA  CPRINT  TURN OFF PUNCH AND EXIT
00688 0FA4 C6 4D      RUBOUT LDA B  #77  SET COUNT
00689 0FA6 86 FF      RUB1 LDA A  #3FF  SET ALL ONES
00690 0FAB 8D 50      BSR  CPRINT  PRINT A RUBOUT
00691 0FAA 5A          DEC B  REDUCE COUNT
00692 0FAB 26 F9      BNE  RUB1  AND KEEP GOING TILL DONE
00693 0FAD 39          RTS  ITS DONE
00694
*8 BIT PRINTER ROUTINE
00695
00696
00697 0FAE 37          BITLOP PSH B  SAVE B REGISTER
00698 0FAB C6 08      LDA B  #8  SET BIT LOOP COUNT
00699 0FAB 36          PUNB1 PSH A  PUSH ON STACK
00700 0FB2 0C          CLC  CLEAR CARRY
00701 0FB3 46          ROR A  SHIFT RIGHT
00702 0FB4 5A          DEC B  REDUCE COUNT
00703 0FB5 26 FA      BNE  PUNB1  NOT DONE YET
00704 0FB7 C6 08      LDA B  #8  SET BIT COUNT AGAIN
00705 0FB9 32          PUNB2 PUL A  FETCH A BYTE OFF STACK
00706 0FBA 46          ROR A  SHIFT INTO CARRY
00707 0FBB 24 06      BCC  PUNB3  NOT A ONE
00708 0FBD 86 50      LDA A  #'P  SET ASCII
00709 0FBF 8D 39      BSR  CPRINT  PRINT A P
00710 0FC1 20 04      BRA  PUNB4  SKIP
00711 0FC3 86 4E      PUNB3 LDA A  #'N  SET ASCII
00712 0FC5 8D 33      BSR  CPRINT  PRINT AN N
00713 0FC7 5A          PUNB4 DEC B  REDUCE BITCOUNT
00714 0FCE 26 EF      BNE  PUNB2  NOT DONE YET
00715 0FCA 33          PUL B  RESTORE B
00716 0FCB 39          POUT  RTS  EXIT, BYTE DONE
00717
*PRINT AN ASCII DATA STRING
00718
*INCREMENT X ONCE EACH CHARACTER
00719
*EXIT WHEN EOT ENCOUNTERED
00720
00721
00722 0FCC          PDATA EQU  *
00723 0FCC A6 00      LDA A  X  FETCH THE DATA
00724 0FCE 81 04      CMP A  #4  IS IT EOT?
00725 0FCE 27 F9      BEQ  POUT  YUP
00726 0FDE 8D 26      BSR  CPRINT  PRINT THE CHARACTER
00727 0FDA 08          INX  UP ONE ADDRESS
00728 0FD5 20 F5      BRA  PDATA  DO IT AGAIN
00729
*PRINT CHARACTER IN A
00730
00731
00732 0FD7          HEXPRT EQU  *
00733 0FD7 84 0F      AND A  #100001111  MASK UPPER BITS
00734 0FD9 81 09      CMP A  #9  CHECK RANGE
00735 0FDB 23 02      BLS  HEX1  0 TO 9
00736 0FDD 88 07      ADD A  #7  A TO F
00737 0FDF 8B 30      HEX1 ADD A  #10010000  MAKE INTO ASCII
00738 0FE1 20 17      BRA  CPRINT  PRINT THE HEX
00739
*PRINT TWO HEX CHARACTERS
00740
*FROM DATA POINTED TO BY X
00741
00742
00743 0FE3          P2HXDA EQU  *
00744 0FE3 A6 00      LDA A  X  FETCH THE DATA
00745 0FE5 47          ASR A
00746 0FE6 47          ASR A
00747 0FE7 47          ASR A
00748 0FE8 47          ASR A
00749 0FE9 8D EC      BSR  HEXPRT  DO UPPER NIBBLE
00750 0FEB A6 00      LDA A  X  PRINT ONE HEX
00751 0FED 08          INX  FETCH THE DATA AGAIN
00752 0FEE 20 E7      BRA  HEXPRT  INCREMENT ADDRESS
00753
*PRINT TWO HEX PLUS SPACE
00754
00755
00756 0FF0          HPRINT EQU  *
00757 0FF0 8D F1      BSR  P2HXDA  PRINT THE BYTE
00758 0FF2 56 20      SPACE LDA A  #20  SET DATA
00759 0FF4 20 04      BRA  CPRINT  PRINT SPACE AND EXIT
00760
*PRINT 4 HEX PLUS SPACE
00761
00762
00763 0FF6          P4HEXS EQU  *
00764 0FF6 8D ED      BSR  P2HXDA  FIRST BYTE
00765 0FF8 20 F6      BRA  HPRINT  SECOND BYTE AND EXIT
00766
*OUTPUT ONE CHARACTER IN 'A'
00767
*B AND X UNALTERED
00768
00769
00770 0FFA          CPRINT EQU  *
00771 0FFA 7E E1D1    JMP  $E1D1  OR OTHER USER VECTOR
00772
*INPUT ONE CHARACTER FROM 'A'
00773
*B AND X UNALTERED
00774
*BIT 7 OF 'A' ACCUMULATOR
00775
*MASKED TO A B
00776
00777
00778 0FFD          CINPUT EQU  *
00779 0FFD 7E E1AC    JMP  $E1AC  OR OTHER USER VECTOR
00780
00781
END

```

# A Text Editor for the

## INTRODUCTION

Extended BASIC interpreters and some assembler packages come with a full text editor that makes it relatively easy to correct typing errors. On the other hand, 4-K and 8-K BASICs have only limited editing capabilities. The Processor Technology Software Package 1 (SP 1) and the Westminster Byte Shop XEK package have editing features that are similar to the smaller BASICs. This article describes a full text editor that can be patched into the SP 1 and XEK packages.

## THE SP 1 AND XEK PACKAGES

Processor Technology has made available to the public the source listing of their SP 1. The monitor portion contains the usual commands to enter hexadecimal numbers into memory, dump a portion of memory to the console, move a block of memory, and branch to another program. (SP 1 was reviewed in the October 1976 issue of *INTERFACE AGE*.) The Byte Shop XEK assembler package is largely based on SP 1 except that it is disk oriented. It was reviewed in the June 1978 issue of *INTERFACE AGE*.

## A LIMITED EDITOR

Both of these packages have provisions for two types of limited editing; one is character oriented, the other is line oriented. If a mistake is noticed immediately after typing it, the DEL (or RUB) key can be pressed. This prints a backarrow (or underline on some terminals) and deletes the character from the input buffer. If the output is sent to a PTCO video display module (VDM), the cursor backs up on the screen. Of course, the DEL key can be pressed repeatedly to delete more than one character.

## REPLACING AN ENTIRE LINE

If an error is not noticed until after the line is completed, the entire line has to be retyped. But if the computerist is not an expert typist, another error may be made when retyping the line. It is difficult to produce error-free text with such a limited editor.

## A FULL TEXT EDITOR

To make the SP 1 and XEK packages more useful, this author has written a full text editor that can be easily patched in. Briefly, the editor uses the line-replacement software present in these packages. The line to be edited is first located in the file buffer, copied to the input buffer, edited while in the input buffer, then copied back to the file buffer. The last step is easily accomplished by making the main package think that the edited line has been entered from the console.

## THE EDIT COMMANDS

The edit commands are similar to those used in the extended BASIC distributed by MITS and TDL. If line 1130 is to be edited, give the command:

CUST 1130

for SP 1 or:

W 1130

for the XEK package. The file area is searched for the requested line. If no such line exists, an error message is printed, and control returns to the monitor. If the line is found, it is copied into the input buffer, and the line number is printed on the console. During the editing session, the H,L register pair is used as a buffer pointer.

Pressing the space bar will print the next character and advance the pointer one byte. Additional pressing of the space bar will successively display the entire line. However, there is a better way to view the text.

### LOOK:

- L Typing an L will display the remainder of the line, output a carriage return, a line feed and print the 4-digit line number to await the next command.

### ADDITIONAL COMMANDS ARE:

### SEARCH:

- S Typing an S followed by a character contained in the line will move the cursor to this character and print the intervening characters.
- nS Typing a number from 1 to 9 before the S will move the cursor to the n-th occurrence of the input character.

### DELETE:

- D Typing a D will delete the next character and embed it in a pair of backslash characters.
- nD Typing a number from 1 to 9 ahead of the D will delete the next n characters. The group of deleted characters is embedded in backslashes.

### INSERT:

- I Typing an I followed by a string of characters will cause these characters to be inserted into the line at the cursor position. Error correction can be made at this time with the DEL key, just as during the initial entry of the line. A backarrow is printed for each character deleted. On a PTCO VDM screen the cursor is backed up deleting the character from the screen.
- The insert mode is terminated one of two ways: by pressing the ESC key, in which case editing may continue, or by typing a carriage return in which case control returns to the monitor.
- X Typing an X moves the cursor to the end of the line and starts the insert mode. This command is used to add characters to the end of a line.

### REPLACE:

- R The R command is a combination of delete and insert. A single R will delete the present character, embedding it in backslashes, then enter all additional characters into the input buffer until an ESC or carriage return command is given.
- nR Typing a number from 1 to 9 ahead of the R will delete the next n characters before entering the edit mode.



```

C&NIN EQU 100
CPFL EQU 0F046H
LINE EQU 0F476H
E&R EQU 0F01FH
WHAT EQU 0F41AH
LMBVE EQU 0F534H
RMBV EQU 0F53DH
FIND EQU 0F505H
SCRN EQU 0F213H
IBUF EQU 0D0ACH
ENDIE

```

```

EDIT1: CALL VCHK ;CHECK THAT A LINE NUMBER
; WAS ENTERED
; CALL FIND ;FIND LINE NUMBER IN FILE
JNZ WHAT ;NO SUCH LINE NUMBER
LXI D,IBUF-1
EDIT2: MOV A,M ;COPY FROM FILE TO IBUF
CPI ASCR ;CR?
STAX D
JZ EDIT3 ;QUIT ON CR
INX H
INX D
JMP EDIT2 ;NEXT CHAR
EDIT3: CALL CRLF ;RESTART LINE
LXI H,IBUF
MOI C,5
EDIT4: MOV B,M ;PRINT LINE NUMBER
CALL JUT8
INX H
DCR C
JNZ EDIT4
EDITIN: MOI C,1 ;SET REPEAT TO 1
EDIN2: CALL IN8 ;INPUT EDIT COMMAND
CPI ' ' ;SPACE MOVES CURSOR
JZ EDSPC
CPI ASCR ;QUIT ON CP
JZ EDEXIT
CPI 'L'
JZ EDLOOK ;LOOK AT LINE
CPI 'Q' ;QUIT
JZ ESR ;RESTORE OPIC LINE
CPI 'I'
JZ EDINSR ;INSERT
CPI 'D'
JZ EDEDEL ;DELETE
CPI 'S'
JZ EDSRCH ;SEARCH
CPI 'R'
JZ EDREPL ;REPLACE
CPI 'X' ;JUMP TO END AND
JZ EEND ;START INSERT
CPI 'V' ;SKIP TO NEXT WORD
JZ EWOPD
CPI 'I' ;CHECK FOR REPEAT FACTOR
JC EDIN3 ;ERROR, < 1
CPI '9'+1
JNC EDIN3 ;ERROR, > 9
SBI 30H ;REMOVE ASCII BIAS
INR A
MOV C,A ;SAVE REPEAT FACTOR
JMP EDIN2 ;GET LETTER COMMAND
EDIN3: MOI B,7 ;RING BELL ON ERROR
CALL JUT8 ;AND RESTART EDIT
JMP EDITIN

; SUBROUTINE TO PRINT PRESENT CHARACTER AND
; ADVANCE THE PRINTER
;
EDSPC: MOV B,M ;ADVANCE PRINTER
CPI ASCR ;END OF LINE
JZ EDIT3 ;RESTART ON END
CALL JUT8 ;PRINT CHARACTER
INX H
JMP EDITIN ;NEXT COMMAND

;
; SUBROUTINE TO PRINT THE REMAINDER OF THE LINE,
; PLACE THE REVISED LINE IN THE FILE,
; AND RETURN TO SOFTWARE PACKAGE 1
;
EDEXIT: CALL SCRW ;PRINT REST OF LINE
LXI H,IBUF
CALL FCR ;GET LINE LENGTH
CALL CRP11 ;PUT CR AND EOF
; INDICATOR AT END OF LINE
JMP LINE ;REPLACE ORIGINAL LINE
; WITH EDITED LINE

;
; SUBROUTINE TO PRINT THE REMAINDER OF THE LINE
; AND RESTART EDIT MODE
;
EDLOOK: CALL SCRW ;PRINT REST OF LINE AND
JMP EDIT3 ;AND RESTART EDIT

;
; SUBROUTINE TO SEARCH FOR THE N-TH OCCURRENCE
; OF AN INPUT CHARACTER. ALL CHARACTERS UP TO
; BUT NOT INCLUDING THE SEARCH CHARACTER ARE PRINTED.
;
EDSRCH: CALL IN8 ;INPUT SEARCH CHARACTER
CPI ' '
JC EDSRCH ;SKIP CONTROL CHARACTER
EDSR4: MOV E,A ;SAVE SEARCH BYTE
MOV B,M
CALL JUT8
INX H
EDSR2: MOV A,M ;FETCH CURRENT BYTE
CPI ASCR ;CARRIAGE RETURN?
JZ EDIT3 ;JUMP ON END OF LINE
CMP E ;COMPARE TO SEARCH BYTE
JNZ EDSR3 ;MOVE PRINTER IF NOT FOUND
DCR C ;A MATCH, DECR COUNT
JZ EDITIN ;JUMP IF N TH OCCURRENCE
EDSR3: MOV B,A
CALL JUT8 ;PRINT CURRENT BYTE
INX H
JMP EDSR2

;
; SKIP TO NEXT WORD

```

```

EOB1 3E20      EWARD: MVI A, ' '
EOC1 C3A3E0     JMP EDSR4

; SUBROUTINE TO INSERT A CHARACTER IN THE LINE
; IT MAY BE AN ESC CHARACTER
;
EDINSR: CALL C0NIN ; GET INSERT CHARACTER
          CPI IBH ; ESCAPE?
          JZ EDITIN ; END INSERT
          CPI ' '
          JC EDINSR ; SKIP CONTRL CHARACTERS
          CPI 7FH ; DELETE?
          JZ EDBACK ; BACKUP CURSOR
          MOV D,A
          JUT8 ; PRINT INSERTED CHAR
          DCX H
          ; FETCH PRESENT CHAR
          CMA ; COMPLEMENT IT
          MOV A,M ; REPLACE IT
          CVA ; USE FOR STOP ON RIGHT SHIFT
          FCR ; FIND CR LOCATION
          MOV D,H
          MOV E,L
          INX H
          CALL RM0V ; SHIFT RIGHT
          MOV M,B ; INSERT CHARACTER
          DCX H
          MOV A,M ; COMPLEMENT BACK
          CMA
          MOV M,A
          INX H
          INX H
          JMP EDINSR ; NEXT INSR

; SUBROUTINE TO DELETE A CHARACTER (WITH DEL
; COMMAND) WHEN IN INSERT MODE. POINTER IS BACKED
; UP ONE AND A BACK ARROW IS PRINTED.
;
EDBACK: MVI A, L0V IBUF ; L0V HALF OF IBUF
          CMP L ; T00 FAR BACK?
          JZ EDITIN ; YES
          DCX H
          MVI B, 5FH ; BACK ARROW
          CALL JUT8 ; PRINT IT
          CALL EDSHL ; DELETE CHARACTER
          JMP EDINSR

; SUBROUTINE TO DELETE N CHARACTERS. DELETED
; CHARACTERS ARE IMBEDDED IN BACKSLASHES.
;
EDDEL1: CALL EDDL2 ; DELETE AND SHIFT LEFT
          JMP EDITIN ; NEXT COMMAND
EDDL2: CALL BACKSL ; PRINT BACKSLASH
          MOV A,M ; FETCH CHARACTER
          CPI ASCR ; END OF LINE?
          JNZ EDDL4
          PSW ; LINE END, RAISE STACK
          JMP EDIT3 ; RESTART LINE
EDDL4: MOV B,M ; FETCH CURRENT CHARACTER
          CALL JUT8 ; PRINT DELETE CHAR
          PUSH B ; SAVE DELETE COUNT (IN C)
          CALL EDSHL
          POP B
          DCX C ; DECREMENT DELETE COUNT
          JNZ EDDL4 ; NEXT DELETE

; BACKSL: MVI B, '\ ' ; PRINT A BACKSLASH
          JUT8

; SUBROUTINE TO REPLACE N CHARACTERS WITH ANY
; NUMBER OF OTHER CHARACTERS. ESCAPE KEY
; RETURNS TO EDIT MODE.
;
EDREPL: CALL EDDL2 ; DELETE AND LEFT SHIFT
          JMP EDINSR ; THEN INSERT

; SUBROUTINE TO SHIFT LEFT THE REMAINDER OF THE LINE
;
EDSHL: PUSH H ; SAVE POINTER
          MOV D,H
          MOV E,L
          INX D
          MVI C, ASCR
          CALL LM0V ; SHIFT LEFT
          MOV M,C ; PUT CARRIAGE RETURN IN
          POP H
          RET

; SUBROUTINE TO PRINT REMAINDER OF LINE. MOVE
; POINTER TO END, AND ENTER INSERT MODE
;
EDEND: CALL SCRNV ; PRINT REMAINDER OF LINE
          JMP EDINSR ; RESTART INSERT MODE

; SUBROUTINE TO FIND THE LINE LENGTH AND ADDRESS OF
; THE CARRIAGE RETURN AT THE END OF THE LINE
;
FCP1: MVI E, 1
      INR E
      MOV A,M ; FIND CR
      CPI ASCR
      RZ
      INX H
      JMP FCP1
      END

000D ASCR      E124 BACKSL      F808 C0NIN      30ED CPLF
0057 CRP11     E0F2 EDBACK     E104 EDDL2     E10A EDDL2
E117 EDDL4     E13B EDEND      E086 EDEXIT     E02B EDIN2
E071 EDIN3     E0C4 EDINSR     E000 EDIT      E00C EDIT2
E018 EDIT3     E020 EDIT4      E029 EDITIN    E095 EDL3JK
E129 EDREPL    E12F EDSHL      E079 EDSPC     E0A9 EDSR2
E0B7 EDSR3     E0A3 EDSR4      E09B EDSRCH    E036 EDR
E0B1 EWRD      0000 FALSE      E141 FCR      E143 FCR1
3526 FIND      40AF IBUF       30C6 INB       349D LINE
3555 LM0V      30DF JUT8       355E RM0V       32A0 SCRNV
FFFF TRUE      3113 VCHK       36D0 WHAT       FFFF XE4VEP

```

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**FOR SALE:** ASR 33 Teletype with stand, box of ribbons, papertape punch and reader; good condition, \$600.00. Allen Tanner, 526 Cleveland Ave., Salt Lake City, UT 84105.

**FOR SALE:** Heath Microprocessor Course and Heath ET-3400 Microprocessor Trainer (completely assembled), including all accessories, instructions, course examination and subscription to Heath Users Group, \$240.00. C. Brandt, 903 Rose St., Barnwell, SC 29812, (803) 259-7211.

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# ADVERTISER INDEX

Info Inquiry Number	Page
<b>MANUFACTURERS</b>	
1	Administrative Systems Inc. ....51
2	Alpha Micro .....14-15
3	Audio Engineering .....54
4	AVR Electronics .....34
5	Bits Inc. ....52
6	Canada Systems, Inc. ....51
7	Computalk Consultants .....50
8	Computer Data Systems .....7
9	Computerland .....18-19
10	Compuworld .....65
11	Cromemco Inc. ....1
13	Data Dynamics, Inc. ....40
15	Data Dynamics Technology .....42
16	dillithium Press .....55
17	Dynabyte .....8-9
18	Electronic Analytic Systems, Inc. ....4
19	Electronic Control Technology .....37
20	EMM/CMP .....26
21	EMM Semi, Inc. ....69
22	Hayden Book Company, Inc. ....33
23	D.C. Hayes Associates, Inc. ....32
24	Info 2000 Corporation .....39
25	Integral Data Systems, Inc. ....30-31
26	INTERFACE AGE Subscriptions .....53
27	and insert between pages 120 & 121
28	INTERFACE AGE Back Issues .....67
29	James Electronics .....IBC
30	Lifeboat Associates .....65, 68
31	Meca .....59
32	Micro Computer Devices Inc. ....37
33	Microdesign, Fullerton, CA .....38
34	Micro Mail .....66
35	Micromation .....22-23
36	Micropolis .....62-63
37	MicroPro International Corporation .....41
38	Micro Technology Unlimited .....58
39	The MicroWorks .....68
40	Mini Micro .....71
41	MPI .....54
42	No Name Computers .....69
43	NCC '79 AFIPS .....12
44	Ohio Scientific .....3
45	OK Machine & Tool Corp. ....64
46	Osborne & Associates, Inc. ....60
47	Otto Electronics .....48
48	Pacific Digital .....67
49	Payne, Jackson & Associates .....91
50	Percom Data Company, Inc. ....24
51	Radio Shack .....11
52	RHS Marketing .....27
53	Seattle Computer Products, Inc. ....16
54	Shugart Associates .....20-21
55	Space Byte Computer Corp. ....29
56	SSI .....50
57	Structured Systems Group .....5, 43-44
58	SWTPC .....IFC
59	Sybex .....10
60	Synertek Systems Corp. ....13
61	Sylvan Hills Laboratories, Inc. ....36
62	System Insights .....28
63	Technico Inc. ....56
64	Terminal Systems .....25
65	Thinker Toys .....35, 45
66	TransNet Corporation .....38
67	Ultra-Violet Products, Inc. ....26
68	U.S. Savings Bonds .....49
69	Vector Electronic Company .....40
70	Vector Graphic Inc. ....BC
71	Xitan Inc. ....47
72	Xitex Corporation .....57
<b>COMPUTER STORES/SURPLUS STORES</b>	
73	Bits N Bytes, Fullerton, CA .....116
74	Byte Shop, Lawndale, CA .....119
75	Byte Shop, Tustin, CA .....122
76	Byte Shop, East .....124
77	Byte Shops of South Florida .....115
78	Colorado Computer Corral .....114
79	Component Sales Inc. ....111
80	Computer Components Inc., Van Nuys, CA .....107
81	Computer Components Inc., Westminster, CA .....105
82	Computer Enterprises .....106
83	Computer Mart Systems, NY .....119, 123
84	Computer Store, Santa Monica, CA .....124
85	Computer Systems Design, Inc. ....141
86	Computerworld .....34
87	Digi-Key Corporation .....118
88	Digital Marketing .....104
89	Electronic Systems .....113
90	International Computer Systems .....112
91	Khalasa Computer Systems Inc. ....110
92	Madison Business Systems .....141
93	MicroAge .....105
94	MiniMicroMart, Inc. ....117
95	Mission Control .....121
96	Quest Electronics .....116
97	Rainbow Computing Inc. ....112
98	Sunshine Computer Company .....103, 109
99	Trinico, International .....125

\*Manufacturer requests factory-direct inquiry.

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26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125
126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175
176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225
226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250
251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275
276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325
326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350
351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375
376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400
401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425
426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450

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☐ Research  
☐ Educator (Professor, Teacher, Assistant, Etc.)  
☐ Hobbyist  
☐ Other

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☐ Direct mail from manufacturers  
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☐ Local computer retailer (store)  
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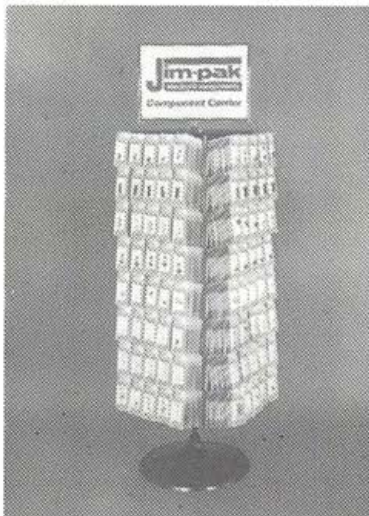
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